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THE GROSS EARNINGS OF 158 RAILWAYS for the month of July are $3,166,350, an increase of 8.96% over the gross earnings during the corresponding month of 1889. The increase per cent. is smaller than for any month of the year with the exception of June. The comparison is made, however, with an exceptionally good month last year, and the actual gain, all things considered, is more satisfactory than the figures indicate. The Southern roads show large gains generally, an indication of the expansion of industry now taking place in that section. In both the Northwest and Southwest, the increase is satisfactory. The eastern roads show losses in some cases, but the majority have quite large increases. Taken as a whole, the figures show a generally favorable condition of the railway transportation business.

RAILWAY COMPETITION IN MANITOBA is not as active as the farmers of that province expected when two years ago they made their fight to secure the Northern Pacific & Manitoba Ry. and to escape from the Canadian Pacific monopoly. The recent announcement that the Northern Pacific & Manitoba is to be consolidated with the Northern Pacific and the headquarters removed to St. Paul has served to complete their disgust. At Brandon the shippers have agreed to boycott the Northern Pacific and ship all their goods over the Canadian Pacific, a somewhat curious outcome of the long war against the Canadian Pacific monopoly which the Manitoba farmers have carried on.

THE BOYNTON BICYCLE ENGINE, it is alleged on newspaper authority, which seems entitled to credence, ran a mile in 32 seconds, or 112 miles an hour, on the Boynton Bicycle Railway at Coney Island last week. The total length of the track is 1¼ miles, about a half-mile of which is on a curve. The time was made on the straight track and the engine drew a bicycle car, double-decked, capable of carrying 108 persons, but only 20 or so were in the car. A full, illustrated description and an editorial discussion of the engine, car and track were given in our issue of March 2, 1889. As we then said, the principle of the device seems one capable of advantageous use, and to be especially adapted to very high speeds.

THE CHIGNECTO SHIP RAILWAY is being pushed along by a force of 1,500 hands. A novel plan has been adopted in the construction of a bridge across the Tidnish River, a small tidal stream two miles from the northern terminus. Instead of building the bridge, which is a massive stone arch structure, across the stream, a site was chosen some distance from the stream, and here excavations were made, the foundations laid, and the arches erected with no trouble at all from water. After completion a new channel will be dug for the river, bringing it around to the bridge, and the embankment will be built acrosss the old channel. Most of the force is engaged on the deep cuts, in which there is a large amount of rock excavation, and in the work at the terminals. The work was described in our issues of Sept. 7 and Sept. 28, 1889. A company has been formed to establish a regular line of steamships between Charlottetown and St. John, and the boats will begin running as soon as the road is completed.

THE PIKE'S PEAK RACK RAILWAY will be completed to the summit late this fall. The building of this road has been difficult, as only the acclimated can labor at an altitude of 14,000 ft. and the work of an ordinary grader is impossibe until he has spent at least two months expanding his lungs so as to accustom them to the rarified air. The roadway has to be graded with the aid of burros, or small donkeys, as horses and carts were unavailable on the rugged and irregular lines of the snow-capped peak. Hundreds of feet above the timber line, immersed in clouds, rain, snow and sleet a good part of the time, the work was continued during last winter. There has naturally been much trouble with employés.

ENGLISH RAILWAYS are doing considerable work now in increasing the traffic facilities of their lines In the neighborhood of London this is especially noticeable, and the work there is very heavy on account of the crowded buildings and the constant traffic. The lines are all above ground on brick viaducts or below ground in open cuts and covered way. The London & Southwestern Ry. has extensive enlargements and improvements under way, and the Great Eastern Ry. also. The estimated cost of the land alone for the enlargement of the Liverpool St. station (the London terminus of the Great Eastern Ry.) is $3,500,000. The company's trouble has been to deal with the housing of the laboring classes; they have been obliged to erect four large buildings containing numerous rooms for those removed from the site of the new station. The company has had trouble in finding sites for these dwellings, because the Home Office required that they should be in the vicinity of the old dwellings. One building is already available, and the others will be so shortly; then the company will be free to commence the great improvement needed for the traffic. It has already overcrowded trains and stations, which it hopes to relieve by the enlargement now to be made; and it hopes to put on an increased number of trains. The works will cost from $1,500,000 to $2,000,000, including the enlargement of the hotel. When that is done, there will be six lines of rails into the Liverpool St. terminus. Upon the $500,000 expended upon artisans' dwellings, the net rental the company will receive will not exceed 2½ per cent.

LETTER BALLOTS have been sent out in the Master Car Builders' Association, to be canvassed Oct. 7, on the propositions submitted by committees at the June convention, viz., for a standard journal box and lid for 60,000-lb. cars; a standard method of loading logs and bark on cars; standard drawbar height of 35 ins. and arrangement of safety chains for passenger train cars; standard inclination of brake-beam lever, of 40 degrees with the vertical; and standard fitting on the end of steam-heat train pipes (a 2-in. female thread fitting with standard pipe thread) as the first step toward standard couplings, enabling these to be readily interchanged when necessary.

THE WORST ACCIDENT OF THE WEEK, and so far as we recall, the worst of its kind which ever happened, occurred Aug. 20 on the Old Colony R. R. near Quincy, Mass., causing 19 deaths and 27 injuries. The accident was a derailment, resulting from a lifting jack left upon the track by a party of section hands, who failed to keep a proper watch for the train then due. Its consequences were more serious than from almost any derailment ever recorded. Both the fatalities and the injuries, however, were due almost wholly, not to the serious nature of the derailment, but to the fact that one car became filled with steam from the locomotive. The circumstances of the accident were substantially as follows, as nearly as can be learned by our representative in advance of the official investigation before the State Railroad Commission:

An express train from Wood's Holl to Boston had just passed Quincy station, and was running at about 40 miles an hour through a cutting about 12 ft. deep. On a curve in this cutting a gang of section men were at work raising track with a jack, and just before the express train reached them a gravel train passed them on the other track. The noise which it made of course drowned the noise of the approaching express train on the track opposite, and they did not see it until it rounded the curve only a few rods away, running at high speed. Whether they were then at work on the track or had stepped aside is not yet known, but the track jack was left between the rails, and when the engineer saw it he put on the air brake.

THE TRACK JACK was then too close to the engine for the speed of the train to be appreciably checked; the engine struck the jack, was derailed and thrown on its side against the bank, so far from the track that the tender, baggage car, smoker and Pullman passed by it, and although derailed, suffered little damage, beyond being ditched just beyond the engine. The fourth car of the train, however, was not so fortunate. It lunged toward the wrecked locomotive and the footboard and rear driver crushed into the middle of the car. Still the accident would not have been so very bad, as may be seen by the fact that although the car was tipped on its side, the windows in the upper side were not broken. Unfortunately, however, the blow-off cock of the locomotive boiler had broken off, and it was located just in the position that the escaping steam and water under boiler pressure poured into the interior of the wrecked car, which formed a veritable steam box. The poor victims close to the escaping steam were scalded to death in a few seconds; others farther away had the presence of mind to break windows on the upper side of the car, and escaped with their lives, although many were badly scalded.

THE OFFICIAL INVESTIGATION before the Railroad Commission, which has been made since the above was written, does not materially alter the story of the disaster as above related. The workman in charge of the fatal jack testified that he did not see the train until it was within *nine yards*. He made one ineffectual attempt to release the jack and jumped to save his life. The pilot struck the jack and tipped it across the rail, and the truck wheel striking it left the track. The escape of steam, which was the chief cause of the fatality, was at the blow-off cock underneath the foot-board. This was not broken off, but was torn out of the sheet, leaving a hole about 2 ins. in diameter, thus blowing the hot water in the boiler directly into the ill-fated coach which had crushed against the engine.

THE ACCIDENT illustrates the need of good discipline among track forces. Since it has been shown what a dangerous obstacle the ordinary track jack may become, it will be well to consider whether more stringent regulations as to its use should not be put in force. Perhaps a track jack of equal efficiency could be designed which would not project above the rail level.

THE CINCINNATI & MUSKINGUM VALLEY ACCIDENT, reported in our issue of Aug. 9, proves not to have been a trestle accident at all, according to a letter from Mr. W. C. CUSHING, but was an unimportant derailment. Three cars of a slow moving freight train left the track at a defective joint, where workmen were laying new steel, and had made a hasty connection to permit the train to pass. The report came to us in a local paper as a trestle accident, an excellent instance of the ability of a good newspaper reporter to make his items interesting no matter what happens or doesn't happen.

Progress in Interlocking Apparatus.

In the accompanying engravings we illustrate the most recent triumph of the Union Switch & Signal Co., a new type of interlocking machine, which is of such merit that it bids fair to rapidly supersede the old type of machine, but which has not as yet been illustrated and described.

Readers of a paper by Mr. R. H. SOULE, on "Railroad Signals and Signaling," presented last winter at a meeting of the New England Railroad Club, and published in our issues of Dec. 21 and 28, 1889, may remember that after referring to other important improvements in interlocking machines introduced by the Union Switch & Signal Co., Mr. SOULE briefly described a new machine which the company was nearly ready to introduce. Since that time this machine has been completed; and, as briefly noted in our issue of July 12, a 58-lever machine of this type has been put in operation at the Broad St. station, Philadelphia, of the Pennsylvania R. R., where it governs the switches and signals on the twelve tracks entering the station, and is giving the best of satisfaction.

While to the engineer unfamiliar with ordinary interlocking machine, the improvements which the new invention effects may not at first be apparent, any one can understand, on even a hasty examination, the fact that the common interlocking machine is a most complicated piece of mechanism. The great advantages claimed for the new machine are that it is much less complicated than the old type, and has a much smaller number of parts. Inspections, additions and repairs are far easier with this machine, and with even a small machine a great number of combinations is possible. For example, on the old type of machine it was frequently necessary to throw the whole apparatus out of service to make even simple repairs on the locking. In large machines of the old type the "locking bars" were very long and it was not seldom the case, when one of these required repairs, that part of the side of the building had to be removed in order to take out the bar. In the new machine to alter or repair the locking mechanism it is only necessary to disturb the immediate piece on which it is desired to work, and the locking bars in even a large machine are never very long, so that generally they can be easily removed. So much more compact is

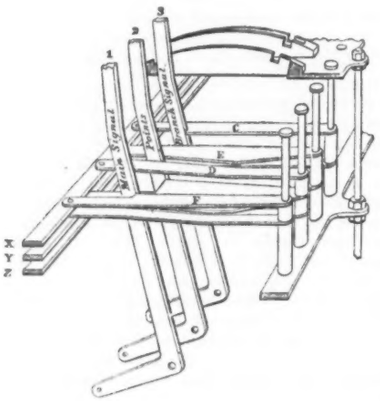


FIG. 1.—An Early Type of Interlocking Machine.

the new mechanism that while a 52-lever machine of the old type would require 48 locking bars, arranged in two tires, each 36 ins. wide, a 52-lever machine of the new type requires only 40 locking bars, arranged all in one tier (giving a great advantage in inspecting, oiling and repairing), and these occupy a space of only 36 ins. in width, or about half that required by the old type of machine. It will be apparent from the above that the machine is not only simple and more efficient but cheaper to construct than the old type machine. While its cost has not yet been accurately determined it is certain the cost of even a small machine will be less than one of the old type, while the saving in cost on a large machine, as well as is its advantages in actual service, will be very considerable.

As the subject of interlocking is one of great importance to our railway men at the present time, it may be well to briefly explain, as clearly as possible, the previous progress which has thus far been made in the complicated art of interlocking, before describing the details of the new mechanism.

Curiously enough, it was not safety but convenience which first led to the assembling of the levers working several adjacent switches and signals at one point. It was found that in this way one man could attend to a larger number of switches and signals, and could work under cover. But with this advantage gained, came the disadvantage that the switchman was more likely to make a blunder than if he walked to each signal or switch and moved it, as by the old plan. Here were, perhaps,

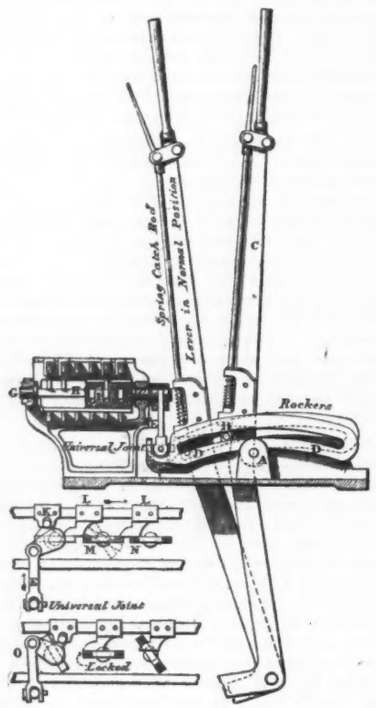


FIG. 2.—The Saxby & Farmer Interlocking Machine.

a dozen levers in the frame before him, each one of which moved a different switch or signal. If through haste or carelessness he moved the wrong lever, he might show a clear signal to a train when danger was intended, or open a switch in front of a rapidly advancing engine.

The first step toward modern interlocking was made in 1847 by STEVENS, who invented a plan by which the signal indicating the position of a switch was moved by a stirrup set immediately below the lever which moved the switch itself. When the switchman moved the lever with his hand, he moved the stirrup with his foot. Still, however, there was nothing to prevent him from carelessly moving one and forgetting to move the other, or, from moving one and not the other. To be properly classed as an interlocking machine, some mechanical connection between the different levers of the frame was necessary.

In 1856 the first real interlocking mechanism was brought into use by SAXBY, who connected the signal levers to the switch levers in such a manner that the signals could never wrongly indicate the position of the switches. This was effected through connections formed by pins working in slots. In following years this invention was much improved upon, and in 1860, the type of machine shown in accompanying cut, Fig. 1, was brought into use by SAXBY and CHAMBERS.

It will be seen that in this machine the locking is effected directly upon the levers. The movements of either of the levers, 1, 2 or 3, move the locking bars *X*, *Y* or *Z*, through its action against the inclined planes on the bars *C*, *D*, *E*, *F*. But these latter bars carry notches or "locks," as shown, and the mechanism may be so arranged that the movement of one lever by the movement of the locking bars and their connected links may lock any bar from moving or release from its lock any bar.

This apparatus is of much historical interest, as marking the first decisive step toward the perfection of modern interlocking apparatus. In practical service, however, it was subject to many defects. A chief one was that the locking mechanism acted on the levers themselves, and thus, when a signalman attempted to move a locked lever, all the strain came upon the locking mechanism. Another defect of the machine was the rapid wear of the levers against the inclined planes, by which the locks did not always move far enough to fasten their proper levers. The greatest fault, however, according to the principles of interlocking as now understood, was that there was no "preliminary locking" in the apparatus. All these grave defects were overcome by SAXBY and FARMER through the employment of the spring catch rod, which has remained in universal use in interlocking apparatus ever since.

Just how perfectly the spring catch rod does its work may be seen by reference to the accompanying engraving, Fig. 2.* Suppose the lever there shown to be one of a large number mounted in a frame side by side (as in the machine shown in Fig. 4). Each of these levers, by connections leading out from its lower end (broken off in the figure), turns some switch or signal. Just to the left of the levers is the locking mechanism, whose office it is to make it always impossible to move the wrong lever. This locking mechanism is actuated solely by the spring catch rod. If the operator is about to move the lever to the left in Fig. 2, he pulls up the spring catch, which movement, by mechanism soon to be described, locks all other levers whose movement it is desired to prevent, and does it *before the beginning of the lever's stroke*. The lever is then pulled over to the end of its stroke, where the block on the end of the spring catch rod drops into the notch on the sector, and in so doing it so moves the locking apparatus as to unlock all other levers whose movement is now safe and may be permitted. Thus all the locking is done before the lever stroke begins, and the unlocking is not done until after the stroke is completed.

The mechanism by which the block on the lower end of the spring catch rod actuates the locking mechanism is a simple one. The lever,

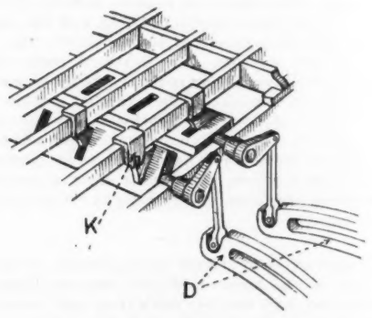


FIG. 3.—Sketch Showing Lock Mechanism of Saxby & Farmer Machine.

sector, and spring latch rod are similar to the reverse lever of a locomotive, but the sector has only a notch at each end. The lower end of the spring catch rod carries a stud, upon which is a small block *B*, traveling in the curved slot in the rocker. Thus the movement of the spring catch rod slightly turns the rocker on its center *A*, and the rocker by the universal joint connection *E* actuates the interlocking apparatus.

Although the rocker is moved by the spring-catch rod, it is held immovable during the transit of the lever from front to back, because its radius then passes through the center of motion of motion of the lever, and the block attached to the spring-

*We reproduce Figs. 1 and 2 from Mr. J. W. BARRY'S excellent little treatise on "Railway Appliances," which, though it describes English practice only, and is now somewhat out of date, is still a volume which deserves a place in every railway engineer's library. To the same book we are indebted for some of the above facts as to the early history of interlocking apparatus.

catch rod simply traverses in the slot without moving the rocker.

To make clear how the movement of the rocker actuates the interlocking apparatus, we give in Fig. 3 a perspective view of the rocker *D*, with the interlocking mechanism to which it is connected. The latter consists of a series of gratings called "flops," each of which is capable of rotation in its bearings when moved by the universal joint connection from the rocker opposite. Above the flops are a series of bars, capable of a sliding motion in the direction of their length. To these are keyed small castings of various shapes. One of these, *K*, known as a "driver," embraces a pin on the flop, so that when the flop turns in its bearings the bar is moved longitudinally. The other castings riveted on the bar are known as "locking dogs." Their office is to prevent the rotation of other flops in their bearings when brought into the proper positions, and in this manner to prevent the movement of the lever belonging to the flop through the Pitman rocker and spring-catch rod connections.

By using different arrangements of the locking dogs upon the lock bars, and different shapes of dogs, almost any desired combinations of locking can be obtained.

This type of machine, known as the Saxby & Farmer machine, is the one now in most common use both here and abroad. It is wholly English in its design, England having been the country which first felt the need of interlocking plant, and having brought the art to a high state of perfection before it was used at all elsewhere. But since interlocking plant began to be used in this country, some 15 years ago, American signal engineers have introduced many improvements, besides that here illustrated, so that now American signal practice is far in advance of the English, even in the original Saxby & Farmer machine just described.

As a prominent instance of this, we quote again from Mr. SOULE'S interesting paper mentioned above. The interlocking machine at the Jersey City terminus of the Central R. R. of New Jersey, made by the Union Switch & Signal Co., has but 66 levers. The estimates for the same plant of Messrs. Saxby & Farmer, the leading English signal engineers, stated that a machine of 185 levers would be required.

This reduction in the number of levers required has been effected in various ways. Originally it was common practice to provide a separate lever for each switch, switch lock and signal. Now it is usual to work the two switches of a cross-over with one lever. It is also usual to move a switch, its lock and its detector bar by a single lever, using, of course, special mechanism to provide for making the various movements in their proper order. A home and a distant signal are often worked by a single lever.

The use of selectors has also been a great factor in reducing the number of signal levers required. The principle is this: given a group of signals only one of which is to show clear at a time, only one lever in the interlocking machine is needed to work them. The wire leading out from this lever runs to the selector, into which on the outer side run wires leading to the various signals to be operated. An automatic mechanism connects any of these with the main wire by a hook gear, which is engaged or disengaged by the movement of the switches. The indicator is another valuable device, by which one of several divergent routes at a signal is designated.

As another striking example of the reduction in the cost and complication of an interlocking apparatus effected by these and similar devices, the interlocking machine at the Grand Central Depot, New York City, may be instanced. This has but 87 levers, whereas if the machine had been built on the old plan without the use of concentrating devices, 176 levers would have been required.

It only remains now to describe the improvements effected by the newly perfected machine of the Union Switch & Signal Co. herewith illustrated. The comparative complication of the Saxby & Farmer machines has already been referred to. The different styles of locking dogs required for the multitudes of different combinations were very numerous. In large machines of the Saxby & Farmer type much difficulty has been found in performing the necessary locking, from the fact that it was impossible to load the catch rod on the lever with more than a certain number of bars, because the spring on the catch rod could not be made strong enough to perform this work. For this reason it became necessary to place on the machine additional levers for the purpose of moving bars in the locking. These levers had no other duty to perform and were not connected with any of the movements outside.

Through the introduction of combined movements the locking in the machine became more complicated, and it became necessary to find some simpler and more comprehensive way of performing special locking. In the new machine the old Saxby & Farmer "flops" and "locking dogs" have been discarded. It revives the use of bars with beveled faces, as in the Stevens system, but under such radically different conditions that the rapid wear which characterized the Stevens locking and seriously impaired its efficiency cannot take place. The working parts of the interlocking mechanism in the new machine are of wrought iron, steel or malleable iron, thus insuring freedom from wear and breakage.

Referring to Fig. 4 it will be seen that the locking bars are placed in pairs. They are no longer actuated by a flop, but by a cylindrical steel rock shaft called the driving shaft, which is connected directly with the universal link, actuated as heretofore by the rocker on the lever-stand. Upon the driving shaft is clamped a cam-shaped device, called the driver, with square jaws engaging with a square block, called the driving piece, fastened to the locking bar and working in trunnions. It is by this train of mechanism that the longitudinal motion of the spring catch rod is made to produce the longitudinal motion of the locking bar.

The locking is effected by small rectangular pieces having the working faces inclined at an angle of 45°. Those which are fastened to the locking bars are called driving dogs (marked *A* in the plan view); those which move at right angles to these are called locking dogs (marked *C* in the plan view). Ordinary locking is effected wholly by the action of these pieces. For special locking a piece called the tongue *T*, is pivoted at one end to the locking bar, and when this locking bar is moved the tongue interposes itself between the locking dogs, thus preventing the movement of a lever which it is intended to lock.

The points of greatest practical value in the new machine were described at the outset of this article. Their importance may be judged by the fact that the machine is now being built by the Union Switch & Signal Co., almost to the exclusion of the old machine, and they report themselves as being willing to guarantee its successful operation.

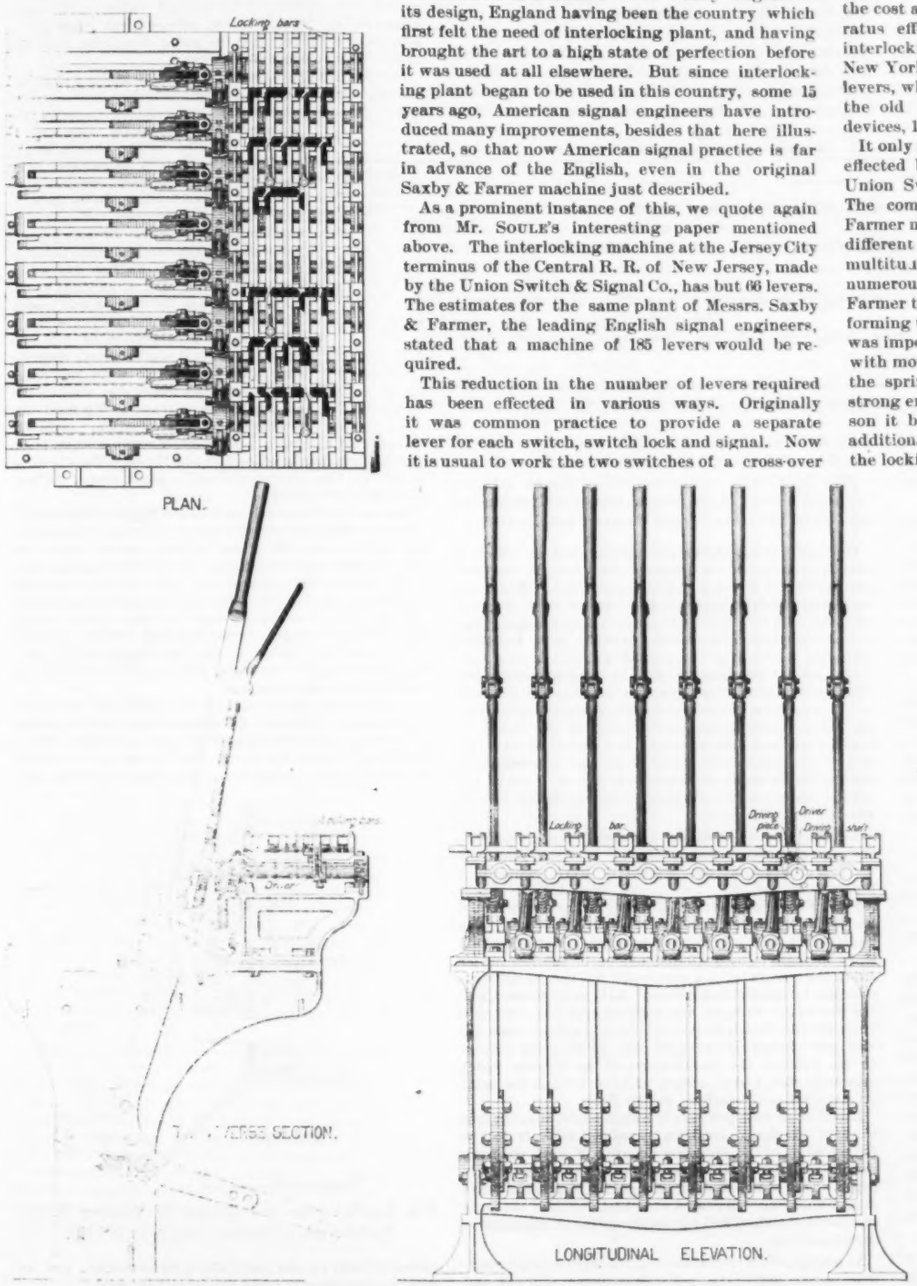


FIG. 4.—PLAN AND ELEVATIONS OF THE UNION SWITCH AND SIGNAL CO'S. NEW INTERLOCKING MACHINE.

Contamination of Waters in Certain Storage Reservoirs on the Pacific Coast, and the Palliatives Resorted to.

The climatic conditions of the Pacific slope render necessary the construction of large storage reservoirs in connection with water supply systems. The most favorable years give no rainfall during six months, and it sometimes happens that no surface water enters the reservoirs from March or April of one year to November or December of the succeeding year, and there may be a succession of dry years. A thoroughly safe water supply system, it is said, should supply storage for a 900-days supply. To secure such large reserves of water use must be made of all the available drainage area, and this, with the character of the surface, results in large deposits of matter in the reservoirs and an eventual contamination of the supply.

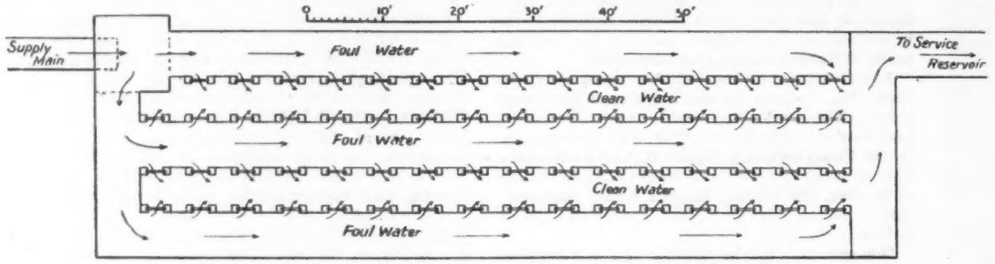


FIG. 1.—PLAN OF WOODEN SCREEN TANKS, SAN FRANCISCO, CAL.

An extensive study of such contamination has been made by L. J. LE CONTE, and some of the results of his observations at the San Francisco and Oakland water-works are embodied in a paper read by him at last meeting of the American Water-Works Association. The paper will be found in full in the official reports of that meeting, and the data in this article is abstracted from advance sheets kindly sent us by Mr. LE CONTE.

The main water supply of San Francisco comes from three large storage reservoirs in the Coast Range Mountains. The Pilarcitos reservoir supplies the high service, and has an available capacity of 1,080,000,000 galls., a water surface of 115 acres, and direct drainage area of 6 sq. miles. Its greatest depth is 85 ft., and the average yearly rainfall at this point is 50 ins. An aqueduct 85,506 ft., or about 16 miles, in length leads to Laguna Honda reservoir, which has a capacity of 33,000,000 galls. This aqueduct consists of three tunnels lined with brick and cement, having an aggregate length of 7,870 ft., a wooden flume 8,300 ft. long, and 69,336 ft. of 30-in. wrought-iron pipe.

The San Andreas reservoir supplies the middle service. It has an available capacity of 6,000,000,000 galls., a depth at the dam of 89 ft., a water surface of 525 acres, a direct drainage area of 4.1 and an indirect of 3 sq. miles. The annual rainfall here is 40 ins. The reservoir has never been filled but once. An aqueduct about 13 miles long leads to the city. It consists of 3,070 ft. of tunnel lined with brick and cement and 64,000 ft. of 30-in. wrought-iron pipe. The aqueduct discharges into the College Hill service reservoir, which has a capacity of 14,000,000 galls. The conduits from the Pilarcitos and San Andreas reservoirs deliver to the city an average of 9,000,000 galls. per day.

The Crystal Springs reservoir supplies the low service and has an available capacity of 3,830,000,000 galls. and a depth at the dam of 46 ft. There are 500 acres of water surface and 15 sq. miles of direct drainage area. The annual rainfall here is 30 ins. The aqueduct leading to the city is about 20 miles long and consists of 8,000 ft. of wooden flume, 9,000 ft. of tunnel and 16.92 miles of 44-in. wrought-iron pipe. It discharges into the University Mound reservoir, which has a capacity of 35,000,000 galls. The aqueduct carries an average of 22,000,000 galls. per day.

Before discharging into the various service reservoirs the water from the aqueducts passes through a screen-house and is strained through cloth screens, as described below.

Oakland's water supply is from the San Leandro and Temescal reservoirs, the greater part coming from the former, which has an available capacity of 4,300,000 galls., a water surface of 410 acres, a depth at the dam of 90 ft. and a drainage area of 40 sq. miles. The water passes from the reservoir through an ordinary fish-screen to a short, double line of 24-in. wrought iron pipe ending in a screen-house, described below. The screened water falls into two uncovered, clear water basins, of 800,000 and 2,000,000 galls., respectively. From these a 37½-in. supply leads some 9 or 10 miles to the city and delivers the water directly to the consumers.

All of the reservoirs are stocked, to a greater or less extent, with fish, principally Californian and Eastern trout, with some black bass, catfish, carp and whitefish from Lake Michigan. It should also be tated that the Pilarcitos reservoir was built in 1864, the San Andreas in 1867, the Crystal Springs in 1877, and the San Leandro at Oakland in 1875.

Mr. LE CONTE continues with what he terms a "general history of the annual troubles affecting the quality of the [these] pond waters," as follows:

Ordinarily in the winter and spring months, which is also the wet season, the quality of the water in the storage reservoirs is comparatively good, the temperature averaging, surface water 48° and bottom 50° Fahr., the only objectionable feature being periodical turbidity due to fine loamy sediment, which is brought in by tributary streams. As soon as the stormy weather is over, the water rapidly becomes clarified by natural subsidence, the time required to complete this operation being generally 2 to 3 weeks. In case of the San Francisco water supply, this difficulty is obviated by shifting the supply to some other source less affected. In the case of Oakland, this is not practicable, since both the reservoirs are equally turbid about the same time, and as a result the muddy waters go into the pipe system and direct to consumers.

As the season advances, the rains cease and the streams run dry. About May 1 of each year the surface waters in the reservoirs have acquired a temperature of 62° Fahr., and the bottom water say 50° Fahr., all vertical circulation has stopped and the period of stagnation begins. Water fleas and some vegetable matter, mostly phænogamous plants, begin to show themselves to a limited extent in shallow water along the margin of the reservoirs, but not in sufficient quantity to amount to anything. As time progresses, and the waters get warmer, the next change observed is a chemical one, that is to say, bubbles of carbonic acid gas and light carbureted hydrogen rise up from the bottom to the surface, the temperature of the bottom water gradually rises, and in course of time attains the same temperature as the surface, say 65° Fahr.

It will be as well, perhaps, to mention here that the true cause of this change has been traced conclusively to the fermentation of the immense deposits of mud covering the entire bottom of these reservoirs, averaging 10 ft. in depth. This bed of mud, of course, has been many years in accumulating. Repeated examinations show that it is composed of animal and vegetable matter in all stages of decomposition.

As a result of this fermentation, the waters of the reservoirs become highly charged with carbonic acid gas, and are robbed of free oxygen as well. Now what do we observe to be the next characteristic feature? Just precisely what might be expected, namely, a sudden and wonderful development of vegetable life, followed almost simultaneously by an equally wonderful development of animal life, principally in the form of water fleas. This vegetable life seems to belong mostly to the variety of cryptogamous plants known as algæ. Later on, when they reach maturity, they break up and develop millions upon millions of tiny green spores, which eventually permeate the whole mass of the ponded waters, imparting to them a beautiful green hue. When these conditions obtain, the spores become a source of great annoyance. They readily pass through the screening apparatus and enter the pipe system, in which they die and decompose, thus injuring the quality of the water delivered to consumers. It is well, perhaps, to mention here that these two items of contamination, vegetable and animal life, at first do no harm whatever to the quality of the water, while they are healthy; on the contrary, their presence in such prodigious quantities is nothing more than nature's endless effort to purify water, *which has been previously injured in quality*, and, furthermore, they would most certainly continue to perform this useful function in nature, but for the advent of the next stage in contamination—we will call it the "Fatal Stage"—and which is most disastrous in its results by giving rise to pernicious conditions, which lead to their death and subsequent decay, all of which is utterly ruinous to the quality of the ponded waters. The main characteristic feature of the fermentation stage above mentioned is the fact that the gases developed give rise to no offensive odors of any kind.

The next change noted in the reservoir is also a chemical one; namely, the fermentation of the bottom mud increases in activity, and in course of time becomes converted into putrefactive fermentation. This stage is at once detected by the change in the quality of the evolved gases rising from the bottom, which now become very offensive. Examination shows them to be carbureted hydrogen; carbonic acid, sulphureted hydrogen. By this process the water in the reservoir soon becomes robbed of nearly all its free oxygen, as instanced by the fish at all times swimming at and near the surface, and becoming very languid in their movements.

During the first portion of this putrefactive stage it was observed that the algæ and animal life were both doing their utmost to purify the water; but as this stage advances the fatal by-products of putrefaction, certainly sulphureted hydrogen, and possibly septic poisons, begin to gain the upper hand, and finally the conditions become so bad that they give up the battle, break up and die and decay in large quantities.

This melancholy condition is called to your attention by masses of dead algæ forming great reddish brown blotches here and there on the water surface, mostly where the gases bubble up in abundance. These blotches soon sink to the bottom, thus adding new fuel to the putrefying matter in the bed of the reservoir. The above lamentable state of affairs exists to a greater or less degree during the months of August, September and October of each year, when the water is at the low stage, and at such times the quality of the water in the storage reservoirs is something almost incredible.

As the season advances, the first change for the better is noticed about the last of October or first of November, when frosty nights set in, and the surface waters become chilled and sink to the bottom, thus giving rise to vertical circulation, which cools the entire body of water, and thus gradually checks putrefactive fermentation, and as a result the offensive odors are greatly reduced.

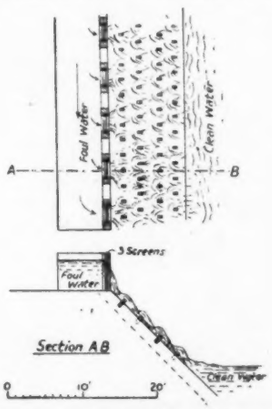


FIG. 2.—Part Plan and Section of Wooden Screen Tanks in use at Oakland, Cal., prior to 1889.

Chemical analysis made at the beginning of this vertical circulation show that the quality of the water is actually worse than at any other time during the year. This fact is undoubtedly due to the filthy bottom waters coming up and mixing with the surface water, thus spoiling the supply to consumers, which, you may say, is always taken from at or near the surface.

But no decided relief from bad water is experienced until the rainfall begins, generally in November, when the reservoir becomes filled up again with a fresh supply of cool surface waters, and the temperature is reduced to 55° Fahr. This fresh supply of rain water is always turbid. There are one or two very important facts connected with these storage reservoirs, upon which I should lay great stress, namely, the San Francisco and Oakland storage reservoirs are equally bad as to quality in midsummer. On the contrary, there exists a very marked difference in the quality of the water as delivered to consumers in the two cities, and this important fact seems to

be due unquestionably to the treatment which the water undergoes after it leaves the lakes. This naturally leads us to the next subject.

A careful study has been made of the quality of the water as delivered to consumers.

First—The San Francisco supply is derived from six different sources, all told, and consequently when the waters in any given storage reservoir become too turbid for use they are enabled to shift the supply from one source to another, less affected, and thus to a large extent avoid delivering muddy water to consumers.

As soon as the rains cease, the water in the reservoirs clarifies rapidly, and in the course of three or four weeks becomes quite clear, and is very good in quality. About the 1st of June, however, offensive odors begin to develop in the supply to consumers in San Francisco, but nothing comparable to that experienced by consumers in Oakland. A careful examination made along the conduits from the reservoirs to San Francisco established conclusively an important fact, namely, that while the waters in the storage reservoirs were very bad, fully as bad as the waters in the Oakland storage reservoirs, yet as we advanced along the conduits it was observed that at all the open flumes and aqueduct tunnels, where the flow of the water was exposed to the air, the quality of the water continued to improve progressively, until finally when it reached the vicinity of the service reservoirs, within the city limits, the quality was

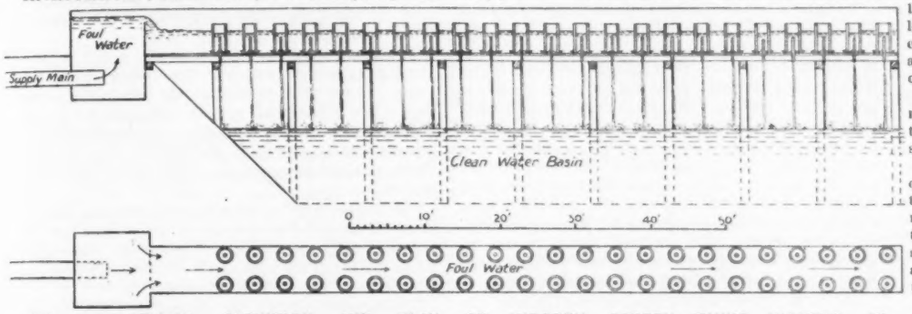


FIG. 3.—SECTIONAL ELEVATION AND PLAN OF WOODEN SCREEN TANKS ADOPTED AT OAKLAND, CAL., IN 1889.

at all times very much better than the surface waters in the storage reservoirs, whence it came, and consequently incomparably better in quality than the water delivered in Oakland.

The experience in Oakland is quite different and deserves careful consideration.

Second—During the winter and spring months the surface water in the reservoirs is allowed to run directly into the supply pipes, sedimentary matters due to storm waters included. As a natural result, more or less sedimentary matter is deposited in the pipe system, and quite extensively in all the dead-ends and fire hydrant branches, in fact everywhere that circulation is poor or bad. During winter storms much of the finer loamy sediment finds its way to the faucets and gives rise to universal complaint. As soon as the rainy season is ended, however, the water improves rapidly, and for a certain period in the spring is clear and really very good.

The supply continues to be reasonably good until about the middle of May, when disagreeable odors begin to develop, and especially when water is drawn from the hot water faucets the odors are excessively offensive. A very important fact should be noticed here, that this offensive stage in the pipe system precedes by one month the same period in the reservoir, and furthermore the most commonplace kind of test, as well as chemical analysis, show conclusively that during the entire putrefactive stage in the reservoirs the water in the pipes supplied to consumers in Oakland is always very much worse than the surface water in the reservoirs, whence it came.

Direct examination shows that the true explanation of this fact may be traced to the deposit of filthy mud in the pipes, which is undergoing putrefaction (similar to that which subsequently takes place in the reservoir on a grand scale), but under infinitely worse conditions, from the fact that it is confined in the pipe system and excluded from contact with the air.

About the middle of June putrefaction begins in the reservoir, and as a result a fresh supply of decaying remains of vegetable and animal matters enter the supply main, thus adding new fuel to the fire and increasing the evil.

Experiments show that these two sources of contamination are sometimes so active and potent that the temperature of the entire water supply to Oakland is affected thereby. About Sept. 1, 1889, the water company began putting in new cloth screens, six thicknesses being used instead of two, as heretofore. A close watch was kept on the temperature of the water in the street mains, and in less than four days following their introduction the temperature of the entire water supply, some 5,000,000 galls. per day, had dropped from 72° Fahr. to 68° Fahr., and then continued at the latter temperature for the remainder of the month.

An examination of the mud in the pipes shows what might be expected, that it is of the same composition as the bottom mud in the reservoir, and also that during the putrefactive stage is very offensive, and contains active red worms.

Any one might naturally think after reading the above that sand-filtration would be the proper remedy to apply in order to improve the water during the summer months. A little reflection will show that the physical conditions are such as to render it impracticable. That is to say, the quantity of vegetable and animal matter in the water in mid-summer is so great in amount that it would clog a filter bed completely in a very short time, and it would consequently cease to work until cleaned. Hence it is interesting to know what is practicable under existing circumstances.

Nothing is done at the San Francisco storage reservoirs to improve the quality of the water before entering the conduits. The water first passes the fish screens and thence through open flumes and aqueduct tunnels, and finally through wrought-iron pipes to the city. At the outlets where they empty into the several service reservoirs is located the so-called screen-house, where the water is made to pass through a system of cloth screens before it is allowed to empty into the service reservoirs. These cloth screens are constructed as shown in detail by Fig. 1. The sash frames are 6 ft. long and 2 ft. wide. Brass wire netting is tacked on, and over that is stretched a good quality of cotton cheese-cloth. In midsummer, when the water is foul with animal and vegetable matter, the screens clog rapidly and have to be removed and clean ones put in their place. The fouled screens are taken to the wash-room, where they are thoroughly cleaned, and the foul wash waters are allowed to escape by a suitable drain-pipe to the bay. Each one of these screen-houses requires the constant employment of double shifts, four

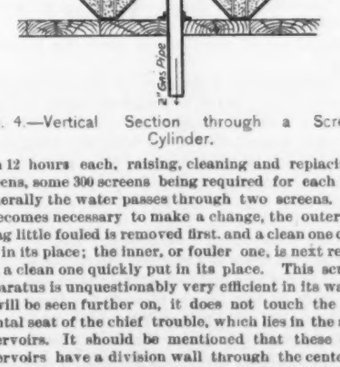


FIG. 4.—Vertical Section through a Screening Cylinder.

men 12 hours each, raising, cleaning and replacing the screens, some 300 screens being required for each house. Generally the water passes through two screens. When it becomes necessary to make a change, the outer screen being little fouled is removed first, and a clean one quickly put in its place; the inner, or fouler one, is next removed and a clean one quickly put in its place. This screening apparatus is unquestionably very efficient in its way, but, as will be seen further on, it does not touch the fundamental seat of the chief trouble, which lies in the storage reservoirs. It should be mentioned that these service reservoirs have a division wall through the center, thus enabling one-half to be emptied and cleaned while the other is in use. In summer this requires careful attention.

The water at Oakland is treated by a different method in some respects, and it is interesting to know that the results obtained are much less satisfactory. Here the screen-house is placed at the storage reservoir, instead of in the city limits, and distant some 9½ miles. Two varieties of screens have been in use, both identical in principle. Those introduced in 1879 are best known in detail by the accompanying drawing, Fig. 2. Those used in 1889 differ only in design. The foul water is made to pass through six thicknesses of cheese cloth wrapped around wire cylinders, and the screening process is necessarily more efficient. This system is shown in detail by Figs. 3 and 4.

The screened water passes into a clean water basin, capacity about 2,000,000 galls., which is not covered. The hot summer sun has developed a large amount of vegetable growth in this basin and a second one has thus been built, thus enabling one to be emptied and cleaned when occasion requires it.

The screened water from the basins passes into the 37½ in. supply main, and travels slowly to the city of Oakland, and direct to the consumers, there being no service reservoir.

In the case of San Francisco, the quality of the water delivered to the consumers throughout the year may be characterized as reasonably good, and as a rule complaints are seldom made, and can always be traced to some local temporary cause. In the case of Oakland, however, the entire water supply delivered to consumers during winter, summer and fall is always bad, but is reasonably good in the spring. In the summer and fall of 1889, when the water in the storage reservoir got very low, a large number of citizens ceased to use the water either for potable or culinary purposes. They organized a company and brought spring water from the hills at considerable expense and inconvenience.

This extraordinary difference in the quality of the water naturally calls for an explanation. After studying over the existing facts, I have come to the following conclusions:

First—Experience at San Francisco shows that the quality of the water is greatly improved by flowing through open flumes and aqueduct tunnels before it reaches the city. On arriving at the service reservoirs, the water is further improved by passing through cloth screens, and thence passes into the distributing reservoir and soon reaches the consumers before secondary deterioration in the pipes has had time to develop.

Second—It is clear that the Oakland Water Co. made a mistake in placing their screening apparatus at the storage reservoir. I sampled the surface water in the latter, and found it to be reasonably good; then I sampled the screen water near by, and found it to be much better. This screened water entered the supply main, and thence travels a distance of 9.5 miles to Oakland consumers. Experience shows that the quality of the water delivered is always worse than the water in the storage reservoir. This secondary deterioration is unquestionably due to the putrefactive fermentation in the pipe system. The water company now proposes to build a 150,000,000-gall. settling reservoir within the city limits, and then transfer the screening apparatus to the same site. I have no doubt but that these new works will improve the quality of the water considerably.

These systems of cloth screens, when properly managed, have certainly proved to be quite effective, as far as they go; but they do not, in my opinion, strike at the fundamental seat of all the worst troubles. This conclusion is based on the results of a long series of observations, which have been under way for four years, and are still going on. They show conclusively that the main trouble from contamination in mid-summer is primarily due to the fermentation and subsequent putrefaction of the immense deposit of oozy mud in the bottom of the reservoirs. Hence the experience on the Pacific coast goes to show that, generally speaking, the older the storage reservoir the worse the troubles become.

The immense deposits of mud in the bottom have been subjected to certain examinations. Its composition is found to be a mixture of vegetable and animal matter in all stages of decomposition interstratified with clayey sediment and vegetable mold brought in by tributary streams in the rainy season. The depth of this deposit averages 10 ft. and in places as much as 20 ft. in the older reservoirs.

It is impossible to conceive how these storage waters can be maintained in a healthy condition as long as this source of contamination is allowed to exist. It must be removed, and the question is, how? In India this is done regularly by emptying the reservoirs, and cleaning them on the first of the monsoons, and then by closing the under-sluices they catch all the subsequent drainage. Of course this is not always practicable. I hereby submit a suggestion, which has developed itself during these examinations.

Samples of mud from the bottom were easily obtained in any desired quantity by means of an ordinary hand pump and 100 ft. of stout rubber hose. The same apparatus was useful in getting the temperature and samples of water at different depths. Now the facility with which this oozy mud could be pumped up, without disturbing the purity of the water in the slightest degree, at once suggested the idea of extending this system, and adopting it as a ready means of getting rid of this objectionable deposit at a comparatively small expense, and without emptying the storage reservoir. Also, I think it proper

to state that a Gwynn centrifugal pump with a runner, 5 ft. diameter, having a suction pipe 17 ins. in. diameter and discharge pipe 15 ins. in diameter, was used under my inspection, to remove a large quantity of black, oozy dock mud. The lower end of the suction pipe was simply allowed to sink down into the oozy mass. The engines were started up, and it was soon ascertained that this kind of material could be removed at the rate of 1,370 cu. yds. per hour, and this rate was maintained for 9½ hours, or a daily capacity of 13,000 cu. yds. and without changing the position of the machine. I merely mention this fact in order to show what has been done in this line.

The next question naturally arises, how will the material be disposed of? In some cases it could be discharged into the creek bed below the dam, and be carried off by storm-waters, or preferably, if there be any shallow flowage or low land near by, heavy embankments of sand faced with gravel could be built, and material pumped behind them, thus making new high land, which would be greatly enhanced in value thereby.

After carefully studying all the facts and circumstances obtainable so far, I am led to draw the following conclusions:

First—That the great deposit of putrid mud in the bottom of storage reservoirs is the primary cause which gives rise to the deterioration in quality of the water. That it should not be allowed to accumulate from year to year, as is generally the case, but should be removed from time to time, and the bottom kept reasonably free from annual deposits capable of undergoing putrefaction. That it is practicable to remove this mud at an expense not much in excess of that incurred in pumping water under like circumptances. That if this is properly attended to, the conditions which give rise to excessive vegetable growth will be practically removed, and as a result vegetable life will become so small in amount as to be a matter of little consideration. That as a final result the construction and maintenance of a system of filter-beds would become entirely practicable.

Second—That the troubles with the quality of the water delivered to consumers are largely independent of the contamination in the storage reservoirs, and can be traced to the turbidity during the stormy months, giving rise to deposits in the pipe system, which subsequently, when the water gets warm, take on putrefactive fermentation, and give rise to offensive odors during the summer and autumn. That this cannot be properly removed except by means of subsidence followed by sand filtration.

Finally, if the above fundamental sources of contamination be eradicated as far as possible, I am of the opinion that the greatest of all reasonable objections to storage waters will be practically removed.

Foreign Practice as to Steel Rails and Rail Tests.

The conclusions which have been drawn from the experiments of Messrs. DUDLEY, of the Pennsylvania R. R.; GRÜNER, Professor of Metallurgy at the Parisian School of Mines; COUARD, of the Lyon Ry. and CAZE, of the Midi Ry., have been so diverse and apparently contradictory that M. MUSSY, Chief Engineer of the French government mines, has attempted to reconcile them in an article in the *Annals des Ponts et Chaussées*, from which we make the following abstract, the abstract covering not our own opinions, but merely those expressed in the article.

In 1877 the Pennsylvania R. R. ordered Mr. DUDLEY to examine the condition of the steel rails recently laid on its lines. In all, 25 rails were examined, 12 in good condition and 13 broken or worn out. Chemical analyses of these rails gave the following average results:

	Good Rails.	Bad Rails.
Carbon	0.287%	0.396%
Silicon	0.044	0. 47
Phosphorus	0.077	0.132
Manganese	0.369	0.521

The physical tests of the bad rails gave an average ultimate strength of 37 to 38 tons per sq. in. and a stretch of 20% in 5-in. bars. The good rails showed an average ultimate strength of 32 to 37 tons per sq. in., with an elongation of 21%.

Mr. DUDLEY decided from these tests that a soft metal was best calculated to resist wear, and drew up the following specifications for the chemical composition of the rails for the Pennsylvania Co.:

P. maximum	0.10%
S. "	0.04
C.	from 0.25 to 0.35
Mn.	" 0.30 to 0.40

The minimum ultimate strength is 33.4 tons per sq. in., and the stretch in a 5-in. bar must equal or exceed 20%.

Three years later 64 rails from the same railway were tested by Mr. DUDLEY. These had been ten years in service, some on tangents, some on curves, and were divided into two classes—those little and those much worn. A bar was cut from the head of each rail and tested chemically and for tensile strength.

The results showed that the rails most worn were those containing the greatest percentage of impurities, sulphur, phosphorus and manganese. It was not possible to draw any very definite conclusions as regards the effects of carbon, since the greatest variation in the amount of that element present was .06%, denoting a very uniform grade of metal. Moreover, the error in analyzing may amount to .02 or .03%.

There is but one thing firmly established by these experiments. In America, the light rail section, the importance of the traffic, and the great speeds have led the railway companies to demand a soft metal—sometimes extra soft, from the manufacturers, [They do so no longer.—ED.] With a soft metal, made necessary by the special circumstances of the track, viz., light section and high speed, and the native ores, the steel which gives the best guarantee against breakage and wear is that which is the most free from impurities, silica, phosphorus, manganese.

To draw other conclusions would be to go beyond the range of facts fixed by experiment. All the metals which were examined come under the class of soft steels; the only rails tested were those rolled from grades of metal differing but slightly as regards their carbon. The quality of the metal used is due greatly to the character of the ores employed in its production. These contain a comparatively small amount of phosphorus, which, however, requires a long blow before it is eliminated in the acid Bessemer process. In this way, the metal becomes soft, and requires the addition of large quantities of very pure and costly spiegel before it can be classed as hard. Hence, the high cost of hard steel rails, of pure metal, forbids their use in America.

In 1883 M. CAZES read a paper before the Iron Institute of Great Britain, in which he stated that the chemical composition of a steel had no more effect upon its character than did the thermal conditions under which it was produced and the amount of rolling to which it was subjected.

The amount of carbon and other elements present in a metal does not determine its strength and durability; they simply indicate what its character will be under given conditions of production.

Experiments of M. TCHERNOFF seem to show that greater variations in the strength of a rail than those attributed to its chemical character by Mr. DUDLEY may be caused by modifications of the process of manufacture. He cut three bars from the same ingot and subjected these to the following tests:

The first bar was broken cold in a testing machine; the ultimate strength was 43 tons per sq. in., the elongation 2.3%. A second bar was heated to a bright red and then hammered by a 3-ton hammer until cooled to such a temperature that the blows had no marked effect, after which the temperature was allowed to sink gradually. Then the bar was tested and showed an ultimate strength of 51 tons per sq. in. and an elongation of 5.3%. A third bar was heated to the temperature at which the working of the second ceased and then gradually cooled; its ultimate strength was 48 tons per sq. in. and its elongation 16.6%.

A second set of experiments gave the following results:

Steel subjected to a pressure of 100 atmospheres, while still liquid, had an ultimate strength of 34 tons per sq. in. and an elongation of 2.4%. The same steel, when annealed, had an ultimate strength of 38 tons per sq. in. and an elongation of 6.7%. The same steel, annealed and rolled, had an ultimate strength of 47 tons per sq. in. and an elongation of 16%.

Another interesting fact brought out by these tests was that there is a marked difference between the steel in the two ends of a rail; that end which corresponds to the larger base of the ingot sometimes shows 10% more strength than the other.

The temperature to which the steel is heated during its production exercises a great influence on its character. While it is not possible to make accurate pyrometric observations between the furnaces of different companies, every good workman can tell the relative temperatures of the furnaces which he tends, and can at once class the ingots from each blow or run as extra hot, hot, average, cold, or extra cold.

When a Siemens furnace has been repaired, it usually takes several days of heating to bring the regenerating chambers to a proper temperature for beginning work. The first runs are extra cold, showing all the characteristics of poor metal, but as the chambers become warmer, the heat to which the metal is subjected becomes greater and the product approaches the soft, homogeneous steel, which is called hot and extra hot. After running for some time, the regenerating chambers become more or less choked with flue-dust and scoria, the gases flow more slowly through the channels and the product again becomes cold and finally extra cold. These facts govern the manufacturers in shipping their steel; that sold for rough work is made during the first or last part of the run of the hearth, while the metal for more delicate articles is produced when the hearth is hot or extra hot.

In general, the soft metal requires a higher temperature than the hard grades. In a well-conducted Siemens furnace, the calorific condition of the hearth must be suited to the more or less refractory nature of the product desired; the softer and more pure the metal, the higher the temperature required to melt it.

The same conditions of heat are noted in the Bessemer process, whether the lining is acid or basic. In the acid converters, the combustible elements are silicon and a little manganese; in the basic process they are phosphorus and a little manganese, and according to the amount of these elements present in the charges will the blows be hot or cold.

The temperature of fusion on the Siemens-Martin hearth is regarded as somewhat lower than that of the acid or basic Bessemer processes, especially when the latter are conducted with charges of 10 or 12 tons.

The experiments of M. COUARD, Engineer of Maintenance of Way on the Paris, Lyons & Mediterranean Ry., lead to the following conclusions:

As regards wear, the Martin rail is inferior to the Bessemer product in the ratio of 1 to 1.2; its hardness, however, is ⅛ greater. From the more important point of view of liability to breaking, crushing, and other accidents, the inferiority of the Martin steel is more manifest. While the Bessemer metal has a record of 0.23% of removed rails in 6 years of wear, the Martin metal showed thrice that number of failures. This is a natural consequence of the lower temperature at which it is produced. The defects, however, are not great enough to trouble the companies employing these rails.

The investigations of M. COUARD were published in the *Revue des chemins de fer* at intervals from 1880 to 1885, and attracted much attention on the Continent. His experiments were conducted for a twofold object: to find the rail giving the greatest resistance to breaking and crushing, and to find the rail showing the least wear.

On 3.567 miles of single track where the rails were 5.2 years old on an average, 8,887 or 0.45% had been replaced up to 1880 as broken, crushed or otherwise injured (except through wear).

These rails were supplied by eight companies whose products were very uniform in quality, although they differed considerably. Careful analyses showed that the best rail as regards resistance to breaking and crushing was that made from the harder grades of steel, the rails being of equally pure metal. If impurities are present, the hard rail is more liable than the soft to break.

It was found, also, that the softer rails were those which wore the most rapidly; the hard metals wore on an average a fifth longer. Hence it will be seen that, under ordinary conditions, the harder the metal, within certain limits, the better is it adapted to withstand the wear to which it is subjected. There is one exception to this rule: soft rails wear best in tunnels. The reason for this is not clear, but it is probably due to the fact that such rails are usually made of purer metal.

In Germany, the steel used for rails is generally softer than in France, approaching at times the [old—ED.] American standard. One of the causes which have led to the adoption of this grade is the fear of breaks caused by variations in the temperature. In Germany, Russia, Sweden, in all countries where the variations in temperature are very great, a

hard metal should not be employed. The amount of carbon and manganese in the French rails is nearly twice that employed in Germany. In England more manganese is employed than is usual elsewhere and the sum of the carbon and manganese in a rail is usually 1.63 to 1.65%. It is these elements which harden a metal, and we are therefore led to class the English rails with the harder ones of the French lines.

The following table shows the present standard specifications for rails on the seven leading French railways.

The leading tests of rails in France are those of resistance to bending and to a suddenly applied load. It has been found that with metals of the same chemical composition the results of these tests often differ widely, while metals which differ considerably in their composition may have the same physical properties; in fact, it is possible that the temperature at which the metal is fused and the successive processes to which it is subjected have an influence on the product which are as important as its chemical composition.

All methods of producing steel, the acid and basic Bessemer, the acid or basic Siemens-Martin, will give a metal suitable for rails, and no special process should be made obligatory. A manufacturer who will guarantee the wear of his rails for a fair length of time should be allowed every means of making them cheaply.

The metal employed must not be so soft as to crush or bend under the loads to which it is subjected; it should rather be as hard as possible without becoming brittle.

The rails ought to be tested under conditions at least approximately similar to those existing on the track. The rails in actual use rest on the ties like a continuous girder and must support the load upon them without permanent set, and must also be strong enough to withstand any unusually great weight, such as would occur if a wheel broke on a track.

The rigidity of the metal can be best determined by supporting the test bar on two supports and gradually loading it until fracture occurs, noting the point at which the permanent set begins with extreme care.

The brittleness is best determined by supporting the test bar on two points of support, and subjecting it to blows from a weight let fall from gradually increasing heights.

These two sets of tests are sufficient to determine the nature of a metal between certain limits approximately those within which it will be strained.

THE MOST IMPORTANT TESTS OF RAILS ON FRENCH RAILWAYS.

No. of test.	Details of tests.	Cie. de l'Est. Vignole rail, 60 lbs.	Cie du Midi. Double-headed rail, 75.2 lbs.	Cie. du Nord. Vignole rails. 60 lbs.	86 lbs.	Cie. de l'Ouest. Double-head. 77.5 lbs.	Vignole. 60 lbs.	Cie. P. L. M. Vignole rails. 77.76 lbs.	68.4 lbs.	Cie. P. O. Double-headed rail. 76.4 lbs.	Cie. de Lyon. Vignole rail. 86-90 lbs.
1. Bending.	Distance between supports	3.61 ft.	3.61 ft.	3.61 ft.	3.28 ft.	3.28 ft.		3.28 ft.		3.28 ft.	3.28 ft.
	Weight at center	37,480 lbs.	44.100 lbs.	37,480 lbs.	57,330 lbs.	35,280 lbs.	30,870 lbs.	66,150 lbs.	55,120 lbs.	40,790 lbs.	57,330 lbs.
	Length of test	5 minutes.	5 minutes.	5 minutes.		5 minutes.		5 minutes.		5 minutes.	5 minutes.
	Permanent set allowed	0	0	0		0		.02 in.		0	0
2. Bending. To be made on same rail as 1	Distance between supports		3.61 ft.	3.28 ft.	3.28 ft.	3.28 ft.		3.28 ft.		3.28 ft.	3.28 ft.
	Weight at center	3.61 ft.	77,170 lbs.	66,150 lbs.	88,200 lbs.	55,120 lbs.	48,510 lbs.	99,200 lbs.	88,200 lbs.	88,200 lbs.	88,200 lbs.
	Length of test	66,150 lbs.	5 minutes.	5 minutes.		5 minutes.		5 minutes.		5 minutes.	5 minutes.
	Max. set allowed	5 minutes.	.008 in. on 1-3 of the rails.	1 in.	1 in.	.02 in.		1.18 ins.		1.18 ins.	1 in.
3. Suddenly applied load. To be made with each of the pieces left from 2, which must be cut to a length between 8.9 and 9.8 ft.		1 in. Afterward load until rupture occurs.	Afterward load until rupture occurs, which must not happen with less than 55 tons.	Afterward load until rupture occurs.		The same rail must support without rupture 88,200 lbs. 77,170 lbs.		Afterward load until rupture occurs.		Afterward load until rupture occurs.	Afterward load until rupture occurs.
	Distance between supports	3.61 ft.	3.61 ft.	3.61 ft.	3.61 ft.	3.61 ft.		3.61 ft.		3.61 ft.	3.61 ft.
	Weight of ram	662 lbs.	662 lbs.	662 lbs.	662 lbs.	662 lbs.		662 lbs.		662 lbs.	662 lbs.
	Height of fall without rupture	7.23 ft.	5.74 ft.	7.23 ft.	9.84 ft.	6.56 ft.		7.54 ft.		4.92 ft.	9.84 ft.

In addition to these leading tests, the Midi line fixes a height of 13 ft. below which the rail must break in the resistance to shock tests. Many of the companies fix the maximum deflections allowed for each length of fall of the ram in the third set of tests, and a few lines conduct tensile tests. The Midi and P. L. M. lines call for a steel which, when formed into a lathe tool and tempered, will cut through the skins of gray and white iron castings respectively, and the same lines demand a steel capable of withstanding uninjured a tensile strain causing an elongation of 0.4 % when the metal has been rolled into leaves for springs and tempered.

It is interesting to note what little importance is attributed in France to the elastic limit, ultimate strength and elongation of the material of the rails. In Germany tests for establishing these limits are deemed of the greatest value. The ductility of the metal is expressed by means of a fraction, of which the denominator is the area of the piece, before testing, and the numerator is the difference of this area, and that after breaking.

The German Railway Union have adopted the following specifications for steel and iron :

STEEL FOR RAILS, TIRES AND JOURNALS.

	First quality.			Second quality.	
	Hard.	Medium.	Soft.	Hard.	Hard.
Min. ult. strength, tons	46.22	39.11	32	30.11	32
Contraction, %	25	35	45	20	30

WELD IRON.

	First quality.	Second quality.
Min. ult. strength, tons	27.03	24.89
Contraction, %	40	25

BOILER PLATE.

	First quality.		Second quality.	
	With the fibres.	Against the fibres.	With the fibres.	Against the fibres.
Min. ult. strength, tons	25.6	22.75	23.47	21.33
Contraction, %	25	15	15	9

A singular empirical rule is in force in parts of Germany to the effect that rails are to be regarded as good if the sum of their tensile strength in kilogrammes per square milimetre plus the contraction in per cent. is approximately 85, which has been found to be the case in tests of over 1,000 good rails. Hence any tensile strength between 65 and 50 kilos. per sq. mm. will pass provided the per cent. of contraction is properly situated between 20 and 35.

The deductions made by M. Mussy, from the facts of which the above is an abstract, are as follows:

The chemical composition of a rail cannot determine the best steel to be employed in the manufacture; it should not be an essential feature in the specifications.

Do Lightning Rods Give Perfect Protection?

A question of much importance to engineers engaged in structural work is the protection afforded by lightning rods. From a lecture by Shelford Bidwell, F. R. S., before the London Institution we make the following abstract:

Within the past two years there has been much controversy over the protection afforded by lightning rods. In a paper read last year before the Institution of Electrical Engineers Dr. Oliver Lodge stated that "the old views on the subject of electrical conduction are hopelessly and absurdly and dangerously inadequate."

Ever since the time of Franklin it has been customary to make use of long pointed metallic rods for the purpose of protecting important buildings from damage by lightning; and the "older electricians," as Dr. Lodge calls them, have always taught that, if the rod were well made of sufficient size and height, and properly connected to earth, it afforded practically perfect security over a certain limited area. The function of the rod was supposed to be not so much to receive the shock of a lightning flash as to prevent a flash from occurring at all in the neighborhood of a protected building; this it did by promoting the silent discharge of electricity between the cloud and the earth through the point of the rod.

In such a case, the efficacy of a lightning conductor would be complete. This is what Dr. Lodge calls the case of "steady strain," where the charged cloud above a building is supposed to have moved into its present threatening position from a distance. According to Dr. Lodge, this is the only kind of lightning discharge which was ever contemplated by the older electricians.

But suppose that a harmless unchanged cloud which might be hovering over a building were suddenly to receive an overflowing charge of electricity by a flash from another more distant cloud. There would then be no time for any gradual relief of the strain by a silent discharge through the lightning conductor, and either the conductor itself or the building would infallibly be struck by a flash from the overflowing cloud.

This case, which, I think, Dr. Lodge was undoubtedly the first to call attention to explicitly in connection with thunderstorms, is called by him the case of "impulsive rush." The occurrence of an "impulsive rush" flash, then, cannot be warded off by a lightning conductor. The most that a conductor can do is to divert the main shock of the discharge from the building to itself. But, even so, the lightning may do considerable damage, for, as Dr. Lodge says, "it is hopeless to pretend to be able to make the lightning conductor so much the easiest path that all others are protected. All possible paths will share the discharge between them, and lots of apparently impossible ones." Moreover, not only is the lightning conductor itself, when struck, liable to spit off sparks laterally, however good its earth connection may be, but other metallic bodies in the neighborhood may do the same, whether such bodies are insulated or not.

The moral appears to be this. In all cases of steady strain in which a charged cloud descending from the upper regions of the air, or approaching from a distance, might inflict serious injury upon an unprotected building, a well designed and properly earth-connected lightning rod is an absolute safeguard. In a case of "impulsive rush," the rod may often be of use in bearing the brunt of the discharge, though sometimes the lightning will take no notice whatever of it, striking the building and altogether neglecting the rod; and it is even possible that a high rod might attract a destructive discharge which otherwise would not have occurred at all. Although, therefore, a lightning rod is in many cases, probably in a very large majority, of the greatest service, it cannot be depended upon as affording perfect immunity from risk; and the assumption which has universally been made by "the older electricians," that damage by lightning is in itself conclusive evidence of some imperfection in the conductor, is an unfounded one.

In conclusion, it may not be out of place to say a word or two on the subject of personal danger from lightning. It appears, from a paper published last year by Inspector-General Lawson, that the number of deaths caused by lightning in England and Wales, from 1852 to 1880, as recorded in the returns of the Registrar-General, was 546, or rather less than 19 per annum. The average population during that period may be taken as 22,000,000; it follows, therefore, that the average annual death rate from lightning was considerably below one per million of the population.

District Messenger Service is only now being introduced in London, the company having been organized with a capital of $1,000,000, and appealing to American experience to show that there is "money in it" in a long prospectus describing how messengers, cabs, fire and police alarms, etc., can be sent, which is somewhat funny reading, considering how old such service is here. An American, R. D. Radcliffe, has been engaged to superintend the business until it is in working order.

The Cernavoda Bridge in Roumania.

On the entire lower Danube from Neusatz to the Black Sea, there is at present no fixed bridge. During the current year a bridge will be begun near Cernavoda, 174 miles from the mouth of the river, which will offer many points of interest on account of its position, the width and depth of the river and the character of the river bed, and the great impetus to Roumanian trade which will be given by its construction. The design of the structure is shown in the illustration taken from the *Centralblatt der Bauverwaltung*, and is the result of several years of study on the part of the engineers of the Roumanian railways, aided by Profs. WINKLER, of Berlin, and COLLIGNON, of Paris.

The bridge carries a single track; it is 2,460 ft. long, having five spans, one of 623 ft. and four of 459 ft. A viaduct 3,150 ft. long, leads to the main structure. The superstructure is to be built of mild steel throughout, and is to be 98.5 ft. above high water at its lowest point. The steel in the plates and angles is to have a tensile strength of 59,740 to 68,270 lbs. per sq. in. and an elongation of 16 to 21 %; that used in rivets must have a strength of 54,050 to 62,580 lbs. per sq. in., and an elongation of 22 %. The allowed strain is 14,220 lbs. per sq. in., which may be increased to 17,070 lbs. per sq. in. by wind strains without necessitating recalculation. The tests are made on pieces of 0.775 sq. ins. area and 7.87 ins. length.

There are two trusses in each part of the bridge; the upper chord is partly straight, partly curved, while the lower chord is always horizontal, the distance between the two being proportional to the maximum bending moments. The depth of the main trusses is 29.5 ft. at the ends, 105 ft. at the piers, and 55.8 ft. in the centre. The panels are of varying length, the longest being 42.7 ft. and the shortest 24.9 ft. The trusses slope downward toward each other at an inclination of 1 10.

In calculating the strains, a train of three 8-wheel locomotives with 6-wheel tenders and an indefinite number of heavy freight cars was employed. The wheel load with the locomotives was 7.15 tons, with the tenders 5.5 tons, and with the cars 4.4 tons. The train was made up in calculating the stress in any piece so as to give the maximum amounts. For the chords, the three locomotives were placed in the middle of the train, two of them being front to front; for the web members, the engines were usually placed at the head, although the first arrangement sometimes gave higher results. A wind pressure of 55.3 lbs. per sq. ft. of unloaded, or 36.9 lbs. per sq. ft. of loaded bridge was assumed in designing the wind trusses, the latter assumption giving the greater strains. The wind bracing is entirely between the lower chords, as in the Forth Bridge, to which structure the designers have repeatedly gone for details.

The total weight of the bridge is estimated at 4,500 tons. The contractors for the superstructure are the Fines-Lille Bridge Co., of France, whose bid of 7,837,278 francs ($1,567,456) was the lowest received. It will probably be five years before the bridge is completed. It need scarcely be said that bridges of this sort, which require several years to design and five years to construct, and are of no greater span than the above, are not in demand in America at the present day.

Plants for the Hydraulic Distribution of Power.

The distribution of power from central stations by the various mediums of steam, gas, electricity, compressed air and water is continually growing in importance.

While the knowledge of the properties of water under pressure, and of the possibility of utilizing these qualities for the distribution of power over a wide area antedates similar knowledge of any of the other mediums above named, hydraulic distribution of power has for the most part been confined to limited areas, owing to the great loss due to the friction in the pipes when distributed through very long mains.

In London and in Hull, England, however, plants for the distribution of water under high pressures have been in use since 1882. The London company has now over 50 miles of mains laid, through which water is distributed at a pressure of 700 lbs. per sq. in. A most valuable feature of the system is its efficiency as an aid in fire protection. The stream from the high pressure mains, acting as an injector, will throw a stream from the ordinary mains with a force equal to that of a heavy fire engine.

In Melbourne, Australia, a successful hydraulic distribution system is also in operation; and at the present time work is far advanced on a system to supply power to the city of Sydney, New South Wales. For the following brief particulars concerning these installations, we are indebted to *The Building and Engineering Journal*, of Sydney.

At Melbourne, about 7 miles of trunk mains are laid, and from these a system of laterals diverge. The water is taken from the Yarra River and carefully filtered to remove all sediment and grit. It is then pumped into the mains and placed under a pressure of about 700 lbs. per sq. in.

The company assert that every system of power hitherto used in Melbourne, whether gas, wormhoist or power obtained from tanks in the roofs of buildings, has been superseded by the public supply of hydraulic power, wherever the mains are laid.

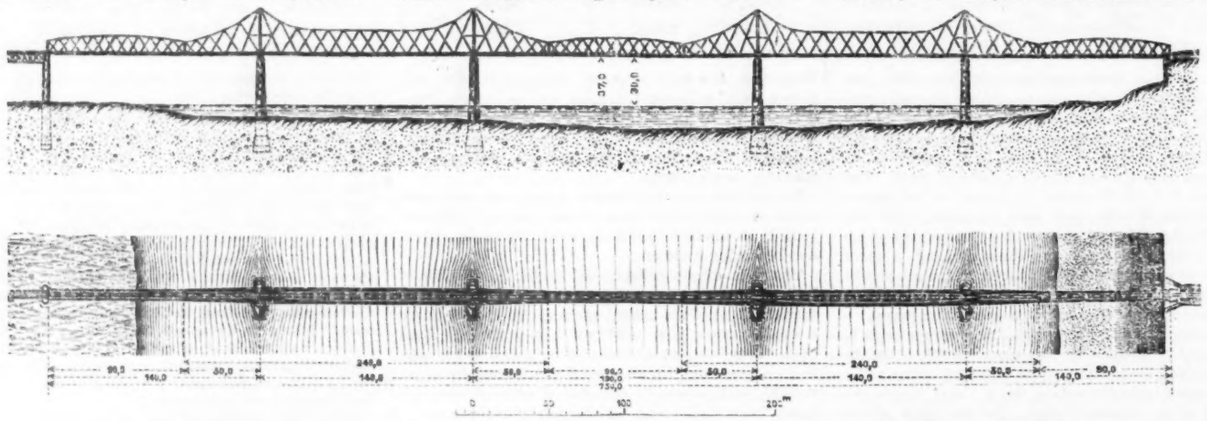
At Sydney the buildings for the Central station are approaching completion and the street mains are being laid. The central station plant is in duplicate and consists of four Lancashire boilers 25 ft. by 7 ft., with 2 ft. 10 in. flues, and three pairs of pumping engines, two pairs of these having cylinders 24 by 30 ins., and one pair of cylinders 16 by 24 ins., the aggregate capacity being 1,200 galls. per minute at a minimum pressure of 750 lbs. per square inch, the 24 in. cylinder engines running at 50 revolutions per minute. There are two accumulators with 20 in. rams of 22 ft. stroke, which have gear for regulating the working of the engines by the rise and fall of the ram. By this means the engines start automatically in any position; and should the first engine not meet the sudden demand for power, a further fall of the accumulator opens the valve and starts No. 2 engine. Should the accumulators fall below a certain point, the engineer is warned by an electric alarm bell, and the standing engine is immediately put into motion.

The laying of the service pipes and the expense for the motor are charged to the consumer. The water used is measured in meters and the charges are on a sliding scale. As illustrating the great difference in the power of water used under such high pressure and under the head used in ordinary water-supply service, the company's circular to consumers states that 5 galls. of the supply from its mains is as effective as 100 galls. from the ordinary town water mains.

Pre-Historic Mines in Mexico.

It has long been a subject of speculation amongst mining men as to whence came the enormous quantities of gold found in the possession of the Aztecs by Cortéz on his arrival in this country, no placer mines such as exist in California and Australia having as yet been found here. It appears to be pretty clear that the Aztecs did not smelt their gold ores, and that they had no means of separating the precious metals, or of treating refractory ores. It follows that veins carrying a considerable *ley* in free gold were the only ones from which gold could be procured. A somewhat curious discovery, bearing not only on this theory but on the immense antiquity of gold mining as a Mexican industry, has lately been made in the State of Chiapas. For a long time, the superintendent of the great Santa Fe copper mine (of which we gave an account in our issue of the 12th inst.) was perfectly satisfied that the mine was absolutely virgin, since none of the immense masses of copper ore, cropping out in all directions, showed the slightest trace of having been touched. True, there was one shallow hole near by, which, however, might easily have been sunk by some wandering prospector during the last few years. Lately, however, it was found necessary to grade out a hillside some 200 yds. from the mine. The hill was densely wooded, but, after felling the timber and excavating 2 ft. of black vegetable mold, traces of ancient workings were discovered, resulting in over 50 metres of an ancient dump being unearthed. This dump was found to contain blocks of rich, gold-bearing copper ore, *thrown away as useless*. The shaft of an old mine was also found. The whole workings appear to be entirely separate from the Santa Fe mine and in a lower formation.

Close following on this interesting discovery comes news from the Victoria mine, half a mile southwest of the Santa Fe. Here, also, there was not the slightest trace of any human being having worked on the mountain, not a dump, not a loose stone, and the ground covered with immense forest trees. A tunnel was being driven to cross cut the ore body, and had gone through over 70 ft. of ore when suddenly an ancient working is blasted into! There are no traces in the neighborhood of any patios, dumps, arrastres, or furnaces; no trace of human habitation beyond an occasional idol found in the caves or hollows in the Santa Fe mine. Three small, broken grinding stones, which might well have been used for maize, were found, but where was the free milling ore treated which came from mines that must have been extensively worked, judging by the extent of the Santa Fe dumps and the depth of the Victoria workings? The exploration of these old mines will be a most interesting work, and may throw fresh light on problems as yet most difficult to solve. There is, we have heard, a tradition still existing in Oaxaca and other gold-producing districts that each grown man in the times of Montezuma was obliged to pay a yearly tax of one quill of gold, and it may be that Chiapas which, till a short time ago, was hardly to be considered a mining State, was, in fact, one of the districts carefully hidden from the Spaniards from which the Mexican Emperor gathered a part of his vast treasures.—*Mexican Financier.*



ELEVATION AND PLAN OF PROPOSED BRIDGE OVER THE DANUBE RIVER AT CERNAVODA, ROUMANIA.

PERSONALS.

Mr. J. J. LANDIS has been appointed Contracting Agent of the Denver & Rio Grande R. R.

Mr. WM. BUCKLEY has been appointed Assistant Master Mechanic of the Louisville, Evansville & St. Louis R. R.

Mr. L. M. ANDERSON, recently Purchasing Agent of the Union Pacific Ry., has been appointed assistant to President Adams.

Superintendent W. W. AIKEN of the Mt. Vernon Bridge Works has resigned. Mr. W. H. PRATT will probably be his successor.

O. H. CHENEY, formerly Superintendent of Sewers, takes the place, it is said, of Wm. R. NORTHWAY as City Engineer of Chicago.

Mr. T. SEYMOUR, formerly with the Columbus & Hocking Valley Ry., has been appointed Superintendent of the St. Louis, Alton & Springfield R. R.

Mr. G. W. TILTON, Superintendent of Rolling Stock of the Chicago & Northwestern Ry., died recently in Chicago from the effects of a railway accident.

Mr. A. H. WATTS has been appointed Master Mechanic of the Cincinnati, Jackson & Mackinaw Ry., with headquarters at Indianapolis, vice, Mr. F. M. DIEBERT, resigned.

Mr. JOHN Y. CUYLER has been appointed by the authorities of Pittsburg, Pa., to prepare plans and specifications for the new public park at Pittsburg, the area of which exceeds 400 acres.

Mr. F. E. PRENDERGAST, Mem. Am. Soc. C. E., recently in charge of St. Mary's Falls Water Power Canal is now Agricultural Superintendent of the San Diego Land & Town Co., with office at National City, Cal.

Mr. JOHN KREY, formerly connected with the Duluth & Iron Range R.R., and Mr. F. L. KUHN, recently Assistant City Engineer of Duluth, have entered into partnership for conducting a general engineering business in Duluth.

Mr. R. C. CARPENTER, for the past fifteen years Professor of Engineering in the Michigan Agricultural College, has accepted the professorship of experimental mechanics in Cornell University. Prof. CARPENTER was the second Secretary of the Michigan Engineering Society, of which organization he was President for the last two years.

NEW PUBLICATIONS.

BOOKS.

—*The Manual of American Water-Works.* Second annual issue. Compiled from special returns, containing the History, Details of Construction, Source and Mode of Water Supply, Pumping Machinery, Dams and Reservoirs, Filters, Distribution, Consumption, Pressure, Hydrant Rental, Revenue and Expenses, Cost and Debt, etc., etc., of every Water-Works in the United States and Canada, with Summaries for Each State and Group of States; Family and Meter Water Rates Charged in 800 Cities; Directory of Water-Works Officials, Engineers and Contractors, and Thirty Illustrations of Dams and Reservoirs. M. N. BAKER, Ph. B., Editor. Cloth, 6¼ × 9¼ ins., pp. LV. and 766. Engineering News Publishing Co., *Tribune* Building, New York. $3.

As this is our publication, compiled by one of our staff, we refrain from general comments regarding the character of the book. As giving a good general idea of the character of the volume, especially as compared with the first annual issue, we quote from the preface, as follows:

This volume contains revised descriptions of all the water-works included in the first issue, together with 310 new works, or 2,047 in all. Official reports for the year closing Jan. 1, 1889, have been received for nearly all the old works, and in each case where, after several requests, the officials have failed to respond, the latest previous returns have been included, with the year to which they apply placed in parenthesis. In the case of new works the date of the latest report has been stated at the close of each description. All works completed prior to March 1, 1890, so far as could be ascertained by the most systematic and persistent inquiry, and many works under construction at that time, or upon which work has been commenced since, are included and described as fully as our reports would permit.

More or less data has been secured and is presented at the close of each State regarding what may well be termed projects of promise. There are 258 of these in the United States and Canada, many of which are now rapidly developing, and some of which have been already put under construction.

Much matter has been added to the former descriptions of the various works, especially regarding dams and reservoirs, some 30 of which are illustrated in the present volume. Most of the latter information and illustrations have been secured by sending a special blank to each water-works having dams and reservoirs, asking for information concerning them. We have also added to the description of each plant, whenever we could secure the information, a statement as to whether the city or town in question had electric lighting and sewerage systems. It is surprising to note that less than 600 towns report a sewerage system.

Perhaps the most important new matter is that given in the back of the book, the family and meter water rates of nearly 800 cities. These have been carefully averaged by States, the averages being for all works, for private works and for public works. Some of the averages are continued in the introduction by groups of States for the whole United States and for Canada. Such a comparison of rates charged for water furnished by public and by private works has never before been made, and never before have so many rates been made available to the public in one collection. The rates and the deductions from them furnish a most important aid to the consideration of private vs. public ownership of water-works and other natural monopolies.

The interest attached to two new features of the MANUAL seems to warrant especial comment. The collection of the additional matter regarding dams and reservoirs was suggested by the failure last year of the South Fork's Dam, near Johnstown, Pa., together with the lack of information on this subject, or at least its unavailability. We propose to continue this work, extending it beyond water-works dams, and ask for the continued cooperation of all who are in a position to give us information. Hundreds of dams are described in the MANUAL, in more or less detail.

The other feature to which we wish to call especial attention is the collection of the family and meter water rates of nearly 800 towns. The various rates are: Family rate (generally the first faucet), pan water closet, bath tub, wash bowl, horse and carriage with use of hose, cow, hose for lawn. These figures have been taken from schedules of water rates kindly sent us by officials. The total of the charges for the fixtures named are given, thus enabling one to compare the rates in a given city with other cities, and with the average for the State, the various groups of States, or the United States. The rates for private are distinguished from those for public works. The meter rates given are the highest and lowest charged in the various towns.

It may startle some to learn that the average family rental of 430 private works in the United States is 43% higher than that of the 318 public works included in the table. The rates are commented upon at length in the Introduction, which contains summaries of the most important data and deductions therefrom.

REPORTS.

—*Report of Proceedings of the Tenth Annual Meeting of the American Water-Works Association held at Chicago, Ill., May 21, 22 and 23, 1889.* Pamph., pp. 185. Six sheets of plates and two portraits. Published by the association. J. M. DIVEN, Elmira, N. Y., Secy. Price 50 cents.

This report contains in addition to the minutes of the meeting the papers there presented and the discussions of the same. The titles of the various papers and some data from the same were published in our issues of May 31 and June 7, pages 513-515 and page 539. An abstract of Mr. EDWIN DARLING'S paper on "The Desirable Efficiency of Hydrants in Connection with Water-Works" was given in our issue of June 7, and in our issue of June 21 we abstracted Mr. J. H. DECKER'S paper on "Who Should Own the Meter, the Department or the Consumer?" In this week's issue we present, with but little omitted, an illustrated paper on "Contamination of Waters in Certain Storage Reservoirs on the Pacific Coast, and the Palliatives Resorted to," by Mr. L. J. LE CONTE.

—*Seventeenth Annual Report of the Board of Water Commissioners of the City of Yonkers, N. Y., December, 1889.* Pamph. Jos. A. LOCKWOOD, Clerk and Supt.

The report contains a valuable table showing for each of the years from 1887 to 1889, inclusive, the amount of water pumped, the amounts distributed unmetered, metered at domestic and special rates, at domestic rate, at special rate; the amount received for each of the above and the rate per cubic foot; also the cost of pumping alone, of pumping and distributing, of pumping, distributing and paying interest on the debt; and, finally, the number of miles of mains, of gates, hydrants, taps and meters at the end of each year.

It seems a great mistake to express quantities in cubic feet in such statistics since their value is largely for purposes of comparison, and the practice in this country is to use gallons rather than cubic feet. Still this is one of the most valuable tables which has come to our notice in a water-works report.

It seems that at Yonkers the water commissioners have charge of the sewers, as at the close of the pamphlet there is a brief report to the commissioners, which relates to sewers.

SOCIETY PROCEEDINGS.

New England Water-Works' Association.—The fall meeting will consist of an excursion of members, with ladies, to the White Mountains. The Boston Society of Civil Engineers will join in the excursion, which will leave Boston at 9:30 A. M., Sept. 13, from the Eastern Railroad station. The party will arrive at the Crawford House at 3:25 P. M., and remain there over Sunday, Sept. 14. During the stay there will be a ride up Mount Willard. On Monday the party will start at 9:15 A. M. for the Profile House, and in the afternoon there will be a carriage drive to the Flume. On Tuesday, at 9:20 A. M., stage will be taken to North Woodstock, and from there the party will proceed to Boston, reaching that city at 5:00 P. M.

The excursion will be under the management of Raymond & Whitcomb, 296 Washington St., Boston, and tickets must be purchased from them on or before Sept. 10. The return tickets will be good until Oct. 1. The price of the tickets will be $22.25, including car fare, the carriage ride and board during the trip. For further information address R. C. P. Coggeshall, Secretary, New Bedford, Mass., or Dexter Brackett, 221 Federal St., Boston.

Civil Engineers' Club of Cleveland, O.—At the meeting on Aug. 12 a communication was read from the Western Society of Engineers, requesting the club to appoint a committee to meet in Chicago, on Tuesday, Oct. 14, 1890, to aid in formulating a plan for holding an International Congress of Engineers at Chicago, in connection with the World's Fair. The president was instructed to appoint a committee of three for this purpose.

The paper of the evening was by Mr. Jas. Ritchie, on "Some Recent Constructions in Railway Bridges." The author began by noting the increased activity in the construction of iron railway bridges in the Southern States. The largest recent bridge of note is that across the Ohio River at Ceredo, W. Va., consisting of one channel span of 518 ft., two side spans, 298 ft. each, and a series of approach spans, the total weighing over 3,250 tons.

In the Southwest, considerable iron bridge construction is going on, and in the Northwest there is an increasing number of these iron bridges; also in the Northeast many bridges are building. The Maine Central R. R. is replacing its wooden bridges by iron, while the New York Central R. R. is building several bridges of steel.

Particular mention was made of a plate girder span of the New York Central, 115 ft. in length and 9 ft. deep, in which the web plates are placed with the fibres vertical. The new swing bridge on the Lake Shore road across the Cuyahoga River, was described as a double track through bridge, 306 ft. long, with steel eye-bars, and the balance of iron. The total weight of the superstructure is 328 tons; the turntable weighs 133 tons.

In commenting upon specifications of bridges, the author regarded those by Mr. Geo. S. Morrison, for the Memphis bridge, as most complete and systematic, and, on account of the minuteness of their details, as not susceptible of evasion. Nothing impossible to comply with should be written in specifications, and all reasonable conditions should be rigidly enforced. The use of steel in bridges seems to be increasing. Many roads allow Bessemer or open hearth to be used, while the New York Central allows the use of acid open-hearth only.

In testing full size iron eye-bars to destruction, the author has noticed that failure takes place near one head or the other, indicating that the material may have been injured in manufacturing, and he recommends annealing, the same as is done with steel bars. Perhaps this would not produce the desired result, but a few experiments in this manner might be of great benefit.

A. H. PORTER, *Secretary.*

New England Roadmasters' Association.—The eighth annual meeting of this association was called to order at the American House, Boston, Mass., at 2 P. M., Aug. 21, by the president, G. W. Bishop (Fitchburg). The session opened with a prayer by the chaplain, J. S. Lane (N. Y., N. H. & H.). The minutes of the last annual meeting were read and approved. The treasurer's report showed that after paying all expenses for the year, about $476, there remained $249.55 cash in the treasury.

The roll call showed rather a thin attendance, only 12 members answering to their names, as follows: J. S. Lane, J. W. Shanks, F. C. Clark, R. Hyland, J. R. Patch, W. F. Ellis, G. W. Bishop, W. E. Clark, J. W. McNamara, S. B. Bodwell, Jr., A. C. Stickney, W. B. Mosher. Other members came later, and 20 to 25 were present during most of the afternoon session.

The following were elected members of the association: Samuel Greer (N. Y., N. H. & H.), J. W. Drew (Old Colony), Bradford Braley (Old Colony), E. Jackman (Boston & Maine), F. Holbrook (N. Y., N. H. & H.), W. L. Dearborn (Boston & Maine), Samuel Letchworth N. Y. & N. E.).

The election of officers for the ensuing year resulted as follows: President, W. E. Clark (H. Valley); Vice-President F. C. Clark (Housatonic); Secretary and Treasurer G. L. R. French (Boston & Maine); Executive Committee, C. B. Lentell, E. W. Horner, F. D. Holbrook, A. C. Stickney; Chaplain, E. W. Horner.

A letter was read from Mr. W. F. ELLIS, Secretary of the Association since its organization at Worcester in 1883, resigning his office and also his active membership in the Association on account of his resignation of his position as Roadmaster of the Providence & Worcester R. R. On motion of F. C. Clark, the regrets of the Association at the necessity of Mr. Ellis resigning his membership were formally expressed together with thanks for his seven years of faithful service, and his resignation was accepted.

Reports of committees on questions for discussion were then presented. On question 1, "Best and most economical method of repairs to track in the winter and spring months," Chairman J. W. Shanks reported that 5 miles of single track or 4 miles of double track were the maximum proper lengths of sections, these lengths to be shortened in

case of extra yard tracks. He advised against the employment of the section hands on work outside of their sections, as it lessened their pride in their work. It is poor economy to cut down section forces where they are most needed. A sufficient force should be kept on in the spring that all new ties may be got in the track by July 1. Most important of all, the roadbed must be of the right kind of material to prevent the action of the frost. The following is an abstract of the discussion :

W. E. CLARK : In preparing for winter, ditches, drains, culverts and watercourses should be thoroughly cleaned. On the Sullivan R. R. in the fall all culverts are packed on the west end, where most exposed, to keep them from freezing up. In the spring, when the frost is coming out, there is sometimes trouble from breaking through the frost into the mud. The only preventive I know of is a thick coat of ballast.

R. HYLAND : The best preparation for winter is to fix the track so that it will not heave. This can only be done by a heavy coat of ballast. This will save shimming uneven tracks, and avoid breaking through.

E. W. HORNER.—Shimming is a necessary evil, and the less that has to be done the better, for it all has to be undone when the frost comes out.

Drainage, of the roadbed and its proper shaping to throw off the rain, will do much to prevent heaving, and if this be properly done a thinner coat of ballast will suffice.

J. S. LANE: I am in favor of stone ballast, and so much in favor that I have taken that up for my business. In regard to the wear of rails under stone ballast, rails are now in use on the New York, New Haven & Hartford; which were in use when stone ballast was first laid on that road and were then badly worn. They have worn far better than they would have under gravel ballast.

Mr. F. C. CLARKE explained the clauses of the report referring to the number of men employed, calling special attention to the tendency on many roads to economize by cutting down section forces.

President BISHOP said that the subgrade was at the bottom of much of the heaving of track. In every pocket of the subgrade water will collect. The only means of overcoming this is to dig out from time to time the worst places and put new material there, properly sloped.

Mr. HORNER: Every cent spent for shimming track is wasted, and worse than wasted, because it is an actual damage to the track. The same money spent for ballast is invested in a permanent improvement.

Secretary FRENCH spoke on the evils of taking the section force off the track for outside work. J. S. LANE referred to the fact that where many extra trains are run and trackmen are required to protect themselves, the efficiency of a given section force is much decreased.

The question of shimming was taken up, and while its necessity was unanimously deplored, it was generally agreed that it was the only resource until good ballast and plenty of it could be applied to the road. In regard to the thickness of shims, several members told of shims 6 to 8 ins. high, and of using one tie on top of another.

Several members said that if properly done, a blocked up track could be as safe as if on the tie; the objection to shimming was the expense and waste of time on work which was only temporary.

It was voted to adopt the report of the committee, and in sending reports to the officers of roads to call their especial attention to the economy to be secured by ample ballasting.

On the second question, "Inspection of Road Bed—daily and yearly inspection—premium system," Chairman J. W. Patch reported that each section master should send a reliable man with his entire section every morning including Sundays, if night and Sunday trains were run; also a man should be sent over the entire section after every heavy storm. The whole line should be inspected by all the section masters together once each year, and there should be a yearly inspection of the road by men competent to judge of its condition. First and second premiums should be offered to section masters who make the best showing for the year.

In the discussion Mr. Lentell described his practice on the eastern division of the Boston & Albany. A man from each section starts on foot at 7 A. M. every day in the year and walks the whole length of the section carrying a hammer and wrench. He looks for broken rails, loose bolts etc., and reports any defect. Perhaps sometime it will be thought best to keep an inspector on the track all the time. At present once a day is deemed sufficient on this road, but this is not enough on all roads by any means. On roads with light rails, poor roadbed, and bad cuts and fills it should be patrolled oftener, and in the morning before the first train. In case of heavy winds or storms men should be out all the time. A mechanical inspection by a machine which is called a spotter or low point marker is a great help in keeping track in good condition. It can be set to show depressions of ¼-in., ⅜-in. or less, and marks ink on the side of the rail. While section foremen are not entirely governed by this, they know when they see ink on the rail that the track is low there and needs tamping even if the rail itself is up to surface.

The yearly inspection takes place about Oct. 1. A special car is used with seats arranged on an elevated inclined plane, so that each gives a good view of the track. The front of the car is of glass and the car is pushed over the road at about 15 miles per hour. The inspection of the whole road requires about four days. The president is very much interested in this, and what he does not see while on this inspection would not fill a very large book. Through him five prizes for division roadmasters and five prizes to the section foremen on each division of $50 each have been established. The prizes are : 1, alignment and surface; 2, joints and spikes; 3, switches and frogs; 4, ballast and sleepers; 5, ditches and cleanliness. The prizes are awarded by marking under each class from 1 to 10, which is done by the four division roadmasters, and the chief engineer or his assistant. At the end of each section the car will stop or slow up, and the marking is done for the section just passed. After the trip is completed the different cards with their marking are given to the chief engineer, who figures up the average, and the prizes are awarded accordingly. It should be said that one man does not know what the others mark. There is no chance of favoritism, as the section foremen only compete on their respective divisions, and each roadmaster does not mark on his own division. After the premiums are awarded, all the section foremen are sent over the road in an inspection car, so that they may see for themselves the qualities of work on the different divisions.

Mr. HORNER said that his experience of trackwalking was that the night inspections which were formerly common were too often unfaithfully done to be of much account. On the whole, while the daily inspection should not be given up, it seems better on the whole to spend the money on permanent improvements which will make the road safer rather than on the wages of men whose work is so often imperfectly done, or not done at all.

Mr. DREW used velocipedes for inspection, and sends a man over the road every day before the first train in the morning.

Mr. SHANKS did not care for a night inspection, unless in case of a storm; but thought inspection was especially necessary in the winter, when rails were likely to break. President BISHOP said that the Fitchburg road is inspected over its whole length twice a day—in the morning before the first passenger train and late in the afternoon.

There was much interest evidenced in the premium system, and in the plan of sending the section foremen over the road, although none but the Boston & Albany road had had experience with it.

On the third question, "Experience with frogs and switches, and the greatest cause of their renewal," Mr. S. B. Bodwell, Jr., of the committee, read the report. Switches in most common use are split and stub switches. The Tyler switch with the castings has had its day. When it was first put into use it was considered safe, and was, generally, with the light rolling stock then in use. The Cook switch is only an improved Tyler; and while it has been widely adopted, it is essentially a stub switch. The great advantage of the split switch is that it gives a continuous rail. No road can afford to use any other for the main line.

As to frogs the committee were of the opinion that the use of badly worn wheels was the chief cause of the renewal of frogs, and that it would be economy to remove wheels before they became badly guttered.

A paper was read by W. F. ELLIS, the publication of which we postpone until next week in order to reproduce a drawing accompanying it.

THURSDAY, AUG. 21.

The discussion of frogs and switches was resumed.

Mr. PATCH spoke on spring rail frogs. He has had them in use for 19 years and has never had a derailment from them. He has four in use which were put in in 1872 and are on the main line under a traffic of 62 trains per day. They have had no repairs whatever. Rigid rail frogs will not run over three years at most where these have run 19.

Mr. HORNER asked if the advantage from the use of spring rail frogs and split switches was the same with light as with heavy rails. Mr. PATCH replied that his experience had been entirely with 56-lb. rails.

Mr. SHANKS said that in the past 10 years he had had 3 spring rails break, but they were spiked so that they could not go out more than so far, and no accident resulted in any case.

President BISHOP thought that a great deal of the rapid wear of frogs was due to poor material under them. Keep filled up with good ballast beneath, and any frog will wear much better.

F. C. CLARK asked, is the spring rail frog under all circumstances as safe as the rigid rail frog?

Mr. PATCH and Mr. ELLIS agreed that it was, Mr. ELLIS stating that he referred to the spring rail frog as now made, not as made years ago.

W. E. CLARK suggested that one reason for the additional safety of the spring rail frog was that wheels were likely to be broken in passing over rigid rail frogs.

F. C. CLARK said that his first experience with spring rail frogs was not at all satisfactory. He had had rigid rail frogs last 15 years with good care under a traffic of about 40 trains a day. He thought the spring rail frog was much safer if made from a heavy rail. The most serious trouble with the spring rail frog was overcome by fastening a brace just back of the joint. Sometimes the spring rails will break.

Mr. STICKNEY said the best spring rail frog was that shown by Mr. ELLIS. Most of the wear is caused by bad wheels. There is an element of danger in the spring rail frog, which does not exist in the rigid frog. The difference, however, is largely in favor of the spring rail frog. He had never had an accident at a spring rail frog.

Mr. MOSHER : There are no spring rail frogs on the Boston & Albany, but there are a good many battered points. We have no frogs over 10 years old, in some places we have to renew frogs every six months. This is generally caused, however, by poor material under the frog. Frogs often have to be renewed in five or six months, because of battered points and wing rails.

The discussion was continued by Messrs. DREW, LANE, CLARK, and others. The members were practically unanimous in favoring the spring rail frog, believing it to be on the whole safer than the rigid rail frog, and vastly more economical. Nearly all insisted on the use of some form of stop to prevent the spring rail from going out too far. A resolution was adopted that the greatest causes of the renewal of switches and frogs were, first, imperfect wheels; second, wheels out of gauge; and, third, neglect by the track department.

F. C. CLARK then brought up the subject of guard rails on facing point switches. He had had two cases within six months of trains split at a switch through a falling brake beam hitting the end of the guard rail, shoving it ahead and turning the switch. No one else had had any trouble of this sort, and several had had the guard rails save the switch from turning in case of a dropped brake beam or similar obstruction. It was also of service to prevent wheels out of gauge from striking the point, and to save wear there. It finally developed that the guard rails which caused the accident mentioned by Mr. CLARK were not properly secured.

The retiring secretary, Mr. W. F. ELLIS, expressed his regret at resigning his membership in the Association.

On the fourth question, "Railroad Ties," R. HYLAND, of the committee, read the report as follows: "The standard tie should be 9 ft. long, 7 ins. thick, and at least 6 ins. face. They should be equally spaced, with large end under the inside rail on curves, 3,600 per mile under all weights of rail.

This topic was discussed by Messrs. SHANKS, PATCH, COLLINS, DREW, CLARK, FRENCH, MOSHER, STONE and others. The 9 ft. tie found no favor, the members agreeing that it was difficult enough to get ties 8 ft. long; and as the tie generally failed by being spiked to death or cutting, the extra foot in length was no gain. It was even an injury in one respect, since it necessitated a wider roadbed, which was less easily drained.

Other points of interest brought out were that the use of large ties was economical, since it cost as much to put in a small tie as a large one, and a less number were required to properly support the rail. Smaller ties, on the other hand, were generally of better timber. It was finally voted that the standard first-class tie should be 8 ft. long, 7ins. thick, and not less than 6 ins. face, laid 3,000 per mile.

J. S. LANE, chairman of committee on review of previous year's discussions, read a brief report, which was adopted as the sense of the convention.

Mr. CLARK called up the previous year's resolution that all members carefully experiment with new devices and methods and report the results at the annual meeting. J. S. LANE gave his experience with the Servis tie plate. He had tried them on the inside of a curve and after a few months removed them to another place. There was no indentation where the tie plate had rested, while on the opposite side the rail had cut into the tie ⅛ to ¼ in. It was voted that each member secure and put into use a sufficient number of Servis tie plates to thoroughly test them, reporting the results at the next annual meeting.

P. S. PERKINS and JAS. M. TORR, of the New York, Providence & Boston, and E. STONE, of the New York & New England, were elected members. The usual resolutions of thanks were voted and the convention adjourned until the third Wednesday in August, 1891.

EXHIBITS AT THE CONVENTION.

These were less numerous than in preceding years. Several exhibits from the West were delayed by the New York Central strike and did not reach Boston. Nut locks were as usual well represented, the exhibits including Ruffner, Dunn & Co.'s Excelsior, the National lock washer, a newly invented device made by the Positive Nut Lock Co., of Jeffersonville, O., and the Jones safety nut lock made at Syracuse, N. Y., which is proving phenomenally popular, 4,000,000 having been sold in the month of July. Geo. R. Campbell, of Bucyrus, O., showed photographs of solid steel frogs, spring guard rails, track hammers, and other railway appliances. The Goldie spike was shown driven into sections of a tie. The Dressel Ry. Lamp Co., of New York, made an excellent exhibit of switch, signal, and hand lamps.

In track jacks the exhibits of Fairbanks, Morse & Co., and Arthur L. Stanford, of Evanston, Ill., were prominent. The former firm also exhibited the Sheffield hand car and other specialties, while the latter showed various track tools. A model of a new woven-wire fence by the Page Woven Wire Fence Co., of Adrian, Mich., and of a new rail joint by the Standard Rail Joint Co., of Boston,

attracted much attention. Among other firms having representatives present were the Dunham Mfg. Co., the Bush Interlocking Bolt Co., the Ramapo Iron Works, and the Carlisle Mfg. Co.

A resolution of thanks was passed by the convention to the firms who made exhibits and a hearty invitation was extended to all manufacturers of supplies in which the road departments are interested to be present at next year's convention.

The Institution of Mechanical Engineers.

[CONTINUED FROM PAGE 145.]

The chief and most interesting paper on the list was that on steel rails. The author, Mr. SANDBERG, is Engineer to the Swedish Government railways, and also the most prominent professional expert on steel rails in Europe, and the reading of his paper attracted some of the leading steel makers and others to hear it.

The author divided his paper into two divisions, taking the chemical aspect of his subject first and following with the mechanical part. He referred to the International Railway Congress held in Paris last year, and based many of his arguments on points there brought forward. The first point taken up in the paper was safety and durability, the general opinion at the congress being that rails should be as hard as is consistent with safety. Hardness can be produced either mechanically or chemically. The former is to be preferred for work put on in the process of manufacture; has not the disadvantages that may follow from the addition of some hardening alloys. The congress, however, simply came to the conclusion that the hard rail not only wears best but is safest.

The crudeness of this statement is to be regretted. If by hardness were meant simply hardness obtained by mechanical treatment, the dictum might be accepted; but its danger from a chemical point of view is apparent. An analysis of Russian rails is given by the author, in which the phosphorous is so high as 0.18%, a degree which Mr. WINDSOR RICHARDS rightly described as alarming. By the series of tests made it appears, to quote the author, that "the English rails are the best and the Russian the worst, because in the latter the percentage of phosphorus is so high as to constitute phosphor steel." We subjoin the table referred to by the author, which is taken from Mr. WERCHOVSKY'S report to the congress:

Description of Steel Rails.	Best.	Good.	Brittle.	Soft.	Russian.	German.	English and French.
Carbon, per cent	0.28	0.28	0.25	0.21	0.22	0.25	0.36
Manganese "	0.67	0.60	0.54	0.74	0.53	0.52	0.61
Silicon "	0.24	0.15	0 11	0.05	0.11	0.16	0.11
Phosphorus "	0.11	0.11	0.18	0.19	0.18	0.12	0.09
Tensile strenth, tons per sq. in	42	41	38	33	36	39	42
Elongation per cent	19	19	20	29	19	19	18
Contraction of area, per cent	36	43	47	53	45	44	40

The figures, so far as they go, speak for themselves, but they also show very plainly that something further is required in determining the value of steel rails. It will be seen that the "soft" rails had so low a tensile strength as to break at 33 tons per sq. in., while the "brittle" rails, with the same percentage of phosphorus as the Russian rails, viz., 0.18, as against 0.09 for English and French, gave very nearly the same tensile strength as the "good" rails, the elongation and contraction of area being greater. The impact tests would have developed the weakness of the "brittle" rails, but there would have yet been the question of hardness, as affecting durability, to determine. Mention was made, during the discussion on the paper, of the hardness machine of Prof. TURNER, of Mason's College, Birmingham. It would be a good thing for railway engineers if this could be brought into successful use, as it would be a great improvement on the present hardness tests with the blunt and sharp-pointed cone. With regard to tensile tests, it may be said that the speakers during the discussion on the paper were pretty unanimous in expressing their opinion of their worthlessness; at any rate in comparison to their cost. The exception perhaps was Mr. WICKSTEED, the inventor of the machine by which tensile tests are made, who said he could forecast the history of the rail by such tests. The table above quoted does not appear to support his theory.

There was another point in connection with tests that came forward during the discussion. The steel-makers protested against engineers specifying that steel should be of a given chemical composition. Let the engineers, they said, be content to prescribe mechanical tests and leave us to fulfill them as best we may so far as the making of our steel is concerned. This would be an unanswerable argument if the mechanical tests were conclusive. One speaker said he looked on the Metropolitan railway as the best rail testing machine in the world. This is very true, and if the other class of testing machines, generally so-called, are very far inferior to it, the engineer is not to be blamed for collecting all the evidence he can as to the character of his rails, and chemicals analysis is a very importat link in the chain.

Speaking of the effect of silicon, the author points out that the "best" rails had a content of 0.24%, which is far higher than any of the other specimens. In this case the phosphorus was 0.11, and it has been stated that with such a percentage silicon and carbon should be low. Engineers often specify only 0.06% of silicon for rails, even when phosphorus is low. This fear of silicon the author explains as due to engineers not discriminating between the requirements of steel for bridges and ship-plates and those for rails, where tensile strength is of small importance. The good effect of silicon, in the author's opinion, is that it forms a slag which absorbs the carbonic oxide gas, which would otherwise form cavities in the ingot, to be afterwards rolled down and cause the rail to laminate. "In the wearing of rails," the author says, "made of these two different kinds of steel (*i. e.*, with and without silicon and with carbon as a hardener), the silicon steel rail is solid and does not peel or laminate. The low carbon steel rail, containing less than 0.30 per cent. of carbon becomes deformed, spread out and crushed at the rail ends, and as it wears it peels off in thin scales, arising from an unsound or spongy ingot. Even when the carbon is as high as 0.40 or 0.50 per cent a tolerably solid ingot cannot be obtained without silicon to the extent of at least 0.10 per cent.; and this percentage of silicon is what the author has generally preferred for steel rails." Further on the author states the following, basing his conclusions on tests quoted: "That a heavy steel rail, containing silicon up to 0.30 per cent., and the same amount of carbon will stand any ordinary transverse test under a falling weight, up to, say, one ton falling 15 ft. midway between bearings 3 ft. apart, provided the phosphorus is low, say under 0.07 per cent., and the manganese not too high. So the large amount of silicon does not seem to make the rail brittle, judging at least from these experiments. That silicon up to 0.30 per cent. makes no visible difference in the hardness."

In the mechanical aspect of the subject the author deals chiefly with the weight of rail, some interesting figures being quoted on this point. "The only safe way to increase the hardness is to increase the weight," the author says. It was this argument that induced the Belgian state railways to adopt the author's "Goliath rail" of 105 lbs. per yard. In speaking upon this question, and in connection with the matter of cost, some interesting figures are given. At the beginning of this year the price in England of old rails was £4 per ton, and at the time of reading the paper the price of new rails was about £5 a ton. Indeed it paid railmakers some time ago, who had old standing contracts, to have their rails rejected, but these facts, of course, are beside the mark. It is a fact, however, that money spent in rails, so long as the prices of old and new rails so nearly approximate, should be looked on more as money invested rather than as money gone, and this is a strong argument in favor of heavier rails.

The following table, taken from the author's paper, is of interest. The figures speak for themselves.

COMPARISON BETWEEN WEIGHT OF RAILS AND OF ENGINES.

F = flange rail. *G* = Goliath rail. *D* = double headed rail. *B* = bull-head rail.

Railways.	Rails. Description and weight in lbs. per yd.	Engines. Weight in tons and number of wheels.
France.	[Centers of sleepers, 3 ft.]	
Nord	*F* 60 without baseplate. *F* 86¼ in 1887.	39, 43¾, 47¼, 51¾, on 8 wheels.
Est	*F* 60 without baseplate. *F* 88½ in 1887.	42 on 6 wheels. 49 on 8 wheels.
Ouest	*D* 60 with chairs. *D* 88 in 1889.	38¾, 41½, 48, on 4 wheels and bogie
Orleans	*D* 76 with chairs. *D* 84 in 1889.	51, 55, on 8 wheels.
Etat et Midi	*D* 76 with chairs.	54 on 8 wheels.
Paris, Lyon, Mediterranee	*F* 68; *F* 78 in 1888. *F* 94 in 1889 with baseplate.	53, 57, on 8 wheels
Belgium.		
Etat	*F* 68 without baseplate. *G* 105 in 1886 with baseplate.	49, 52 on 8 wheels.
Grand Central	*F* 68 without baseplate.	52 on 8 wheels.
Italy.	*F* 72 without baseplate. *F* 84 in 1889.	47.
England.	[Centers of sleepers, 2 ft. 6 in.]	
London & North Western	*B* 90 and B 82; with chairs 40 lbs. to 50 lbs. each.	42 on 6 wheels.
Great Northern	*B* 85.	42 "
Midland	*B* 85.	43 "
Great Western	*B* 86.	42 "
Great Eastern	*B* 86.	42 "
North "	*B* 90.	43 "
South "	*B* 84.	42 "
London, Chatham, and Dover	*B* 84.	42 "
America.	[Centers of sleepers, 2 ft.]	
Pennsylvania	*F* 60 to 80 without baseplate.	60 on 8 wheels with bogie.

The author devotes some space to the discussion of the respective merits of the double-headed, the bull-headed, and the flange rail, but we do not see that any fresh light is thrown on the subject.

Speaking of the American flange rail, the author says:

The main feature of the American standard rail sections is that the height is equal to the width of base, while in Europe the height is much greater than the width of base. This makes the sole-plate all the more needed in Europe; but the author is convinced that it will before long be needed in America as well, although their bogie system of rolling stock is a great advantage in saving their track. Another feature of the American standard section of rail is a flatter top, say 12-in. radius, and a sharp upper corner of the head. There is even one enthusiastic advocate for an absolutely flat rail head and cylindrical wheels. The 12-in. radius for the top may suit Europe as well; but even if any rail head were made quite flat-topped it would soon wear down to even less than a 12-in. radius, since the present conical tires worn to a rounded section could not all be converted in a moment into cylindrical wheels. The sharp upper corner of ¼-in. radius no doubt suits the American bogie vehicles; but as not half the rolling stock in Europe is yet fitted with bogies or radial axle-boxes, it seems better to round the top corner a little more, *so as not to risk running off on the curves.*

[We take the liberty of italicizing this part of Mr. SANDBERG'S statement, and of remarking that he is sadly off from the truth in it, one of the great advantages of the sharper corner being to diminish the tendency to derailment with any kind of rolling stock.—ED.]

The lower corner of the rail head is rounded with ½-in to 3-32-in. radius in America. [1-16-in. is that recommended as standard.—ED.] This corner the author now makes quite a sharp edge, in order to get the full bearing for the fishplate; and he finds there is not the slightest difficulty to the maker. With this improved bearing of the fishplate, the rail joint with angle fishplates can be made equal in strength to the solid rail, as in the specimens exhibited. The great difference in the head of the Goliath rail is that it is made both wider and thinner than in the American rails generally, and has vertical instead of sloping sides, whereby two objects are attained; firstly, greater durability, because the thick narrow rail-heads have worn badly in consequence of their interior being less compact than the surface; and, secondly, the wider rail head approaching to the width of the wearing surface of the tire will give greater tractive power to the engine, and diminish or supersede the necessity of turning up both engine and carriage tires. The latest section of the Goliath rail is accordingly made with 3-in. width of head, for both flange and bull-head section.

The question of the necessity of a more stable base is also discussed, but we do not see that any fresh light is thrown on the subject beyond that of the Paris Conference. The paper concludes with some remarks as to the influence of speed on safety and economy, the author's general conclusion being that the cost of construction is very nearly proportional to the speed actually run. The author adds:

The distribution of the weight upon a greater number of axles, so as not to exceed a certain load upon each, seems to the author to be a true principle only so long as the speed is slow. With high speed, say 60 miles an hour, he is of opinion that the rail between the supports of the sleepers has no time to regain its original position between the passage of each wheel and hardly between that of each carriage; so that the weight of the whole train, or at least of the whole engine, acts like one single blow upon the rail from one rolling ball; and therefore it is the total weight of the engine that should properly be taken into account when running at high speed, and not the weight per wheel or per axle.

We have given so much space to Mr. SANDBERG'S paper that we are unable to deal with the contributions of other authors at any length. This, however, we do not regret, as there was not much more of more than very ordinary interest to record. Mr. BAINBRIDGE'S paper was Baconian in its range; taking all science (of mining) for its province; from "The Hardy Pick" upwards. The description of the Sheffield Water works and that of the Park Gate Iron Works were both of the baldest catalogue description, while Mr. OAKMAN'S paper dealt with a product - Loomis gas—which is doubtless better known in American than in England. It may interest Americans, however, to hear that one of our leading crucible cast steel firms, the Messrs. FIRTH, have found that they can save 50% in the cost of fuel by adopting this gas; but then, the way in which crucible cast steel is melted has not altered for one hundred years, and about 90% of the heat goes up the chimney.

—"*We've all been there before, many a time,*" is the expressive title under a photograph sent us by Mr. E. T. ABBOTT, Chief Engineer of the St. Anthony Lumber Co.'s R. R., showing a locating party in the heart of a Northern Minnesota pinery. It is a camp scene, with the mess table in the foreground and the party grouped in the rear. The men are evidently just in from work on the line and dinner is awaiting them, served in a row of tin basins, arranged on a table of round sticks. We suspect that the plate must have been an "instantaneous exposure" or the crowd would not have consented to wait for a photograph before attacking the baked beans and brown bread. The picture, we understand, to be "for private circulation only;" but it or some similar picture ought to be in the portfolio of every engineering school in order that the students might have a proper appreciation of the hard times and jolly times in store for them,—hard to each or jolly to each, according to his temperament and temper.

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D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
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GEO. H. FROST.....BUSINESS MANAGER

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Advertising rates. 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon;* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

New York Railway Club.—Next meeting, Aug. 21. Rooms, 118 Liberty St.

Engineers' Club of Cincinnati.—Next meeting, Aug. 28. Secy., J. F. Wilson.

Civil Engineers' Society of St. Paul.—Next meeting, Sept. 1. Secy., G. L. Wilson.

Western Society of Engineers.—Next meeting, Sept. 2. Secy., J. W. Weston, 230 La Salle St., Chicago.

American Society of Civil Engineers.—Next meeting, Sept. 3. Secy., John Bogart, 127 E. 23d St., New York.

Boston Society of Engineers.—Next meeting, Sept. 3. Rooms, 67 Washington Street.

Association of Civil Engineers of Dallas.—Next meeting, Sept. 5. Secy., E. K. Smoot, Elm and Austin Sts.

Engineers' Club of Philadelphia.—Next meeting, Sept. 6. Secy., Howard Murphy, 1122 Girard St.

Civil Engineers' Club of Cleveland.—Next meeting, Sept. 9. Secy., C. O. Palmer, 22 Cedar Ave.

Civil Engineers' Association of Kansas.—Next meeting, Sept 10. Secy., J. C. Herring, Wichita, Kan.

Engineering Association of the Southwest.—Next meeting, Sept. 11. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

Western Railway Club.—Next meeting, Sept. 16. Rooms, Phenix Building, Chicago.

Engineers' Society of Western Pennsylvania.—Next meeting, Sept. 16. Secy., S. M. Wickersham, Pittsburg, Pa.

Engineers' Club of St. Louis.—Next meeting, Sept. 17. Secy., W. H. Bryan, 30 South 7th St.

Boston Society of Civil Engineers.—Next meeting, Sept. 17. Secy., S. E. Tinkham.

American Society of Railway Superintendents.—Annual meeting at New York on the day preceding the fall meeting of the General Time Convention. Secy., C. A. Hammond, 350 Atlantic Ave., Boston, Mass.

THE horrible disaster on the Old Colony road, noticed elsewhere, should not be interpreted as indicating any like danger from the use of steam for heating. It is, of course, quite impossible to wreck a car on top of the ruptured boiler of a locomotive and not have the steam work terrible havoc, since it escapes in great volume at high pressure; but some careful tests on the Boston & Albany, which we have many times referred to, showed that from the small pipes used for steam heating no volume of steam could escape which would do any harm two or three feet beyond the point of escape until there had been ample time to open or smash enough windows to make further continuous escape harmless. Fortunately, steam heating has now advanced so far beyond the experimental stage as to make a caution on this point almost needless, but less pertinent occurrences have been seized on before now by those anxious to find excuses.

The accident occurred but a short distance from the scene of the Wollaston accident of Oct. 8, 1878, and was of almost equal fatality, though the number of injured was much larger at Wollaston. The latter accident, however, resulted from the old familiar cause of negligence in operating (switches misplaced by a freight train on the time of a passenger train), while this later accident is due to the very unusual cause (for a serious accident) of negligence by the trackmen; and the negligence was extreme if it be true, as now appears, that the track gang was at work with jacks lifting the track without having guards or flags out in each direction. The jack seems to have probably been in place beneath the rail when the engine struck it, and the man in charge of it failed to keep the proper lookout. It is contrary to every principle of good railroading to obstruct the track under any circumstances, still less near a curve and on a curved road, without flags out.

THE New York Central strike may or may not be substantially over, but now seems an appropriate time to say that in one respect at least the rights of the men were violated, and in a way which in the long run can lead only to disaster in the conduct of such controversies. It is the natural right of every free man to be represented in negotiations with another man, either in person or by attorney, as he may elect, and any attempt to limit his choice of attorney is not only contrary to the ordinary rules of business life but inherently inequitable, and, therefore, "worse than a crime, a blunder," which invites the defeat that in the end will surely follow. But three causes will justify a refusal to receive and confer with any person whatsoever who claims to be the authorized attorney of another: (1) that he is not in fact so authorized, (2) that no dealings or relations are desired with his principals, (3) that he is personally offensive or unmannerly. No one of these three causes for refusal existed in the case of the last strike, and it was, therefore, an entirely unwarrantable encroachment on the rights of the men for Mr. WEBB to refuse to confer with their authorized representatives prior to the strike. If they were "not railroad men" or otherwise incompetent attorneys, so much the worse for those who chose them. He has a perfect right to discharge men for belonging to sufficiently obnoxious organizations. An organization for promoting train wreckage, for example, would be properly held to disqualify all its members from railway service. Whether the Knights of Labor is an organization of like obnoxious nature, or whether the men were discharged for belonging to it or not, are questions of fact which we are not now discussing; but even the officers of such obnoxious organizations, if they in fact represent employés whose continued services are desired, have a right *to be heard* in their representative capacity. The men fully understand, as do also their superiors, that in many ways they are at a disadvantage in personal conferences. Any attempt to limit their choice of attorneys for such conferences is a hardship, and as such will be resented and in the end ineffectual.

THE official report of the English Home Office on the terrible colliery explosion of last February at Llanerch, Wales, by which 176 persons lost their lives, is most extraordinary reading, for it shows with singular vividness the difficulty of making miners show any respect for their own lives, without which, of course, it is quite hopeless to make the colliery owners, whose lives are not endangered, take any deep interest in providing precautions for which those who are to be protected do not thank them. It appears that the explosion was wholly due to the use of naked lamps. Four months before the government inspector had recommended the use of safety lamps, and the owners were willing to use them, although it entailed an additional cost of some 7½ per cent. in wages. But the men, hearing of the correspondence, sent a delegation of their own to examine the mine, as they are entitled to do under the Act, and they reported strongly against the use of safety lamps, declaring the mine perfectly safe. So things went on until a few days before the accident, when there were distinct warnings of some interior change, which were wholly neglected, while the gas was quietly gathering for its deadly work. Then came the awful accident, then the inquest, and then a lot of testimony from the very men concerned, like this from one of the miners, which will bear repeating, as showing how difficult it is to deal with men of this kind:

Have you an objection to use a locked lamp?—Yes.

What is your objection?—It do mean a great deal of trouble to a collier in getting his coal, because he has not sufficient light to get his coal. Another thing is that it impairs the eyesight of the collier.

Are these objections, or do you think it unnecessary?—I always thought it unnecessary there (*i. e.*, in Llanerch pit).

You mean that you thought that there was not likely to be any such quantity of inflammable gas as to render the use of naked lights dangerous?—I never thought we would need them with the ventilation that was there.

Assuming that locked lamps had been thought desirable by any one of experience, do you say the workmen would not have been willing to use them?—I don't think that the workmen would be willing to use them at any price.

Has this explosion satisfied the men that the use of naked lights in that mine has been a dangerous practice?—I cannot speak as to the other men.

Speak of yourself.—I should prefer working with the naked light yet.

In the face of this calamity brought under your eyes?—Yes.

Then with you it is not a matter of increased wages?—No.

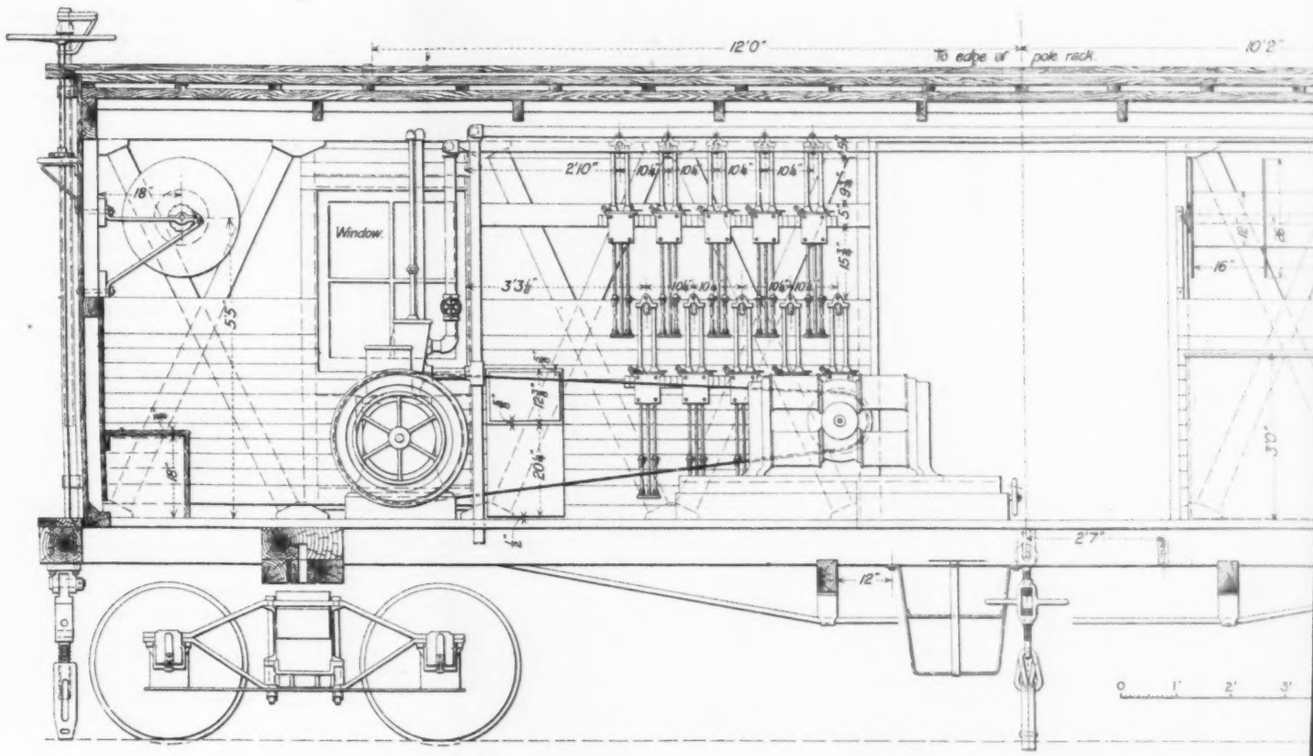
Am I to understand that you would like the practice which has now been introduced since this explosion to be discontinued, and have a return to naked lights?—Yes.

The Second Interstate Commerce Report.

The second annual report of the Statistician of the Interstate Commerce Commission, advance proofs of which have just reached us, is a very great advance upon its predecessor; so great as to encourage the hope that in a year or two more we shall have a volume of national railway statistics in all respects worthy of the country; and so great as to lead one to look with much charity on the defects of omission and commission still remaining, which are of some importance. We shall confine ourselves for the most part, however, to a review and discussion of the new facts which the report makes available, some of which are of great interest and novelty, with only incidental reference to the report itself.

It is unfortunate that the years covered by this report and by Poor's Manual are not the same, at least nominally, Poor's purporting to extend up to Jan. 1, 1890, while this report is only for the year ending June 30, 1888. This report, however, is precisely what it says it is, while Poor's is what the latest reports offered happen to be, so the difference is much less than appears. On the whole, comparison indicates a fairly close correspondence between the two, the difference being rarely more than the difference in date would seem to warrant. It will therefore be needless to specify the comparisons in detail.

One regrettable deficiency in the report just issued results from the law under which it is prepared. Roads wholly in one State and not engaged in interstate commerce do not report to the commission, and these roads aggregate 7,810 miles out of the reported total of 157,759. This should not be. To properly "regulate commerce between the States" it is necessary to know what all roads are doing, if not to regulate all, and the law should



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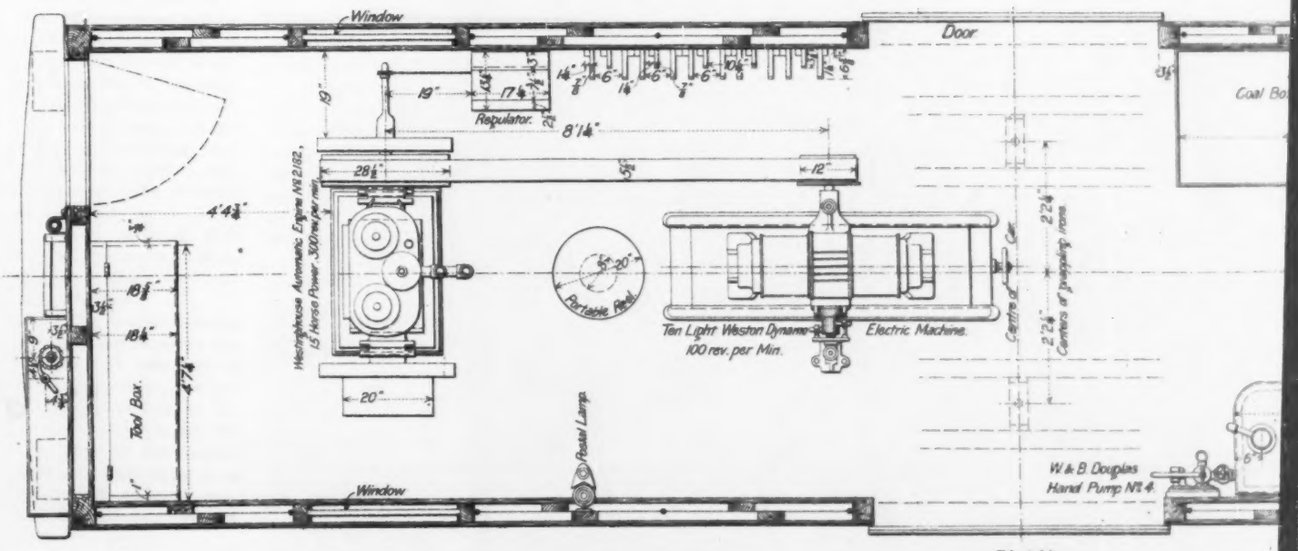
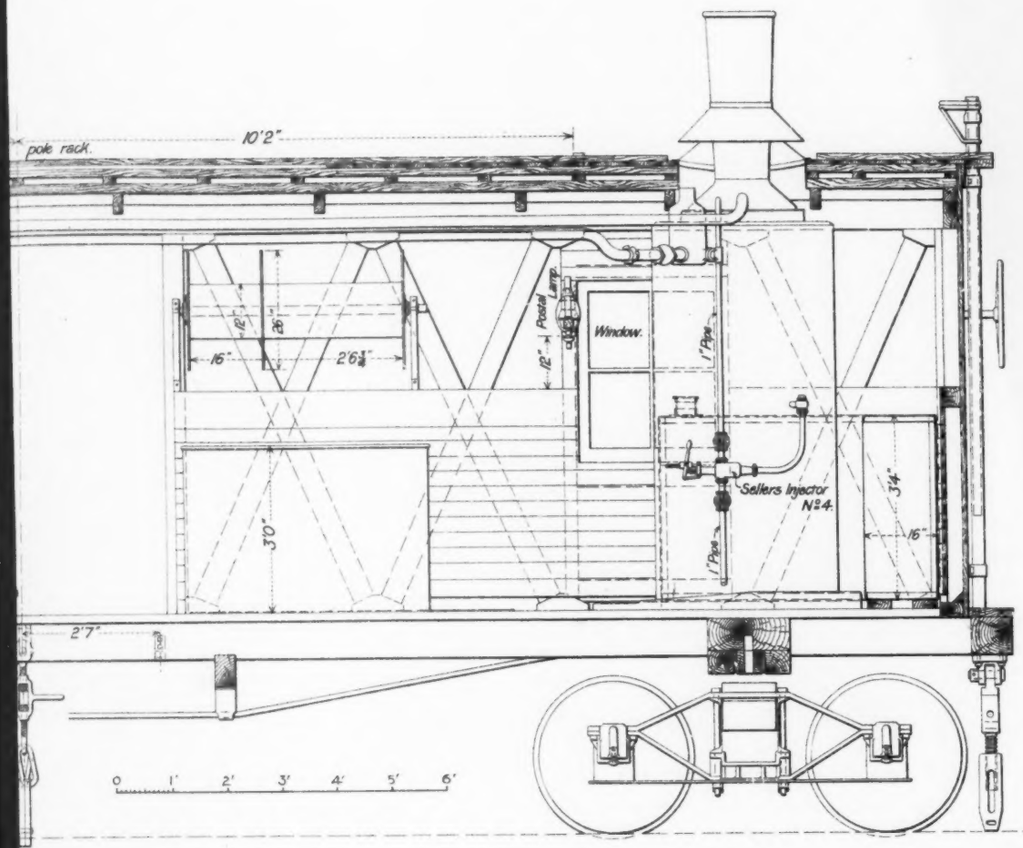


PLAN.

ELECTRIC LIGHT CAR

THEODORE N. ELY, G



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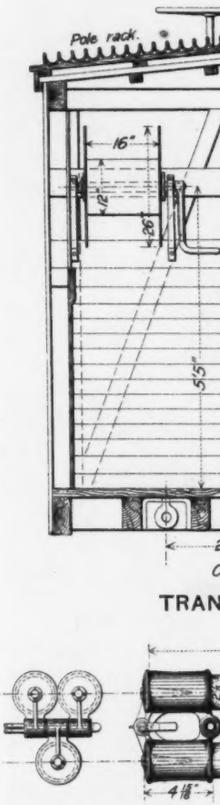

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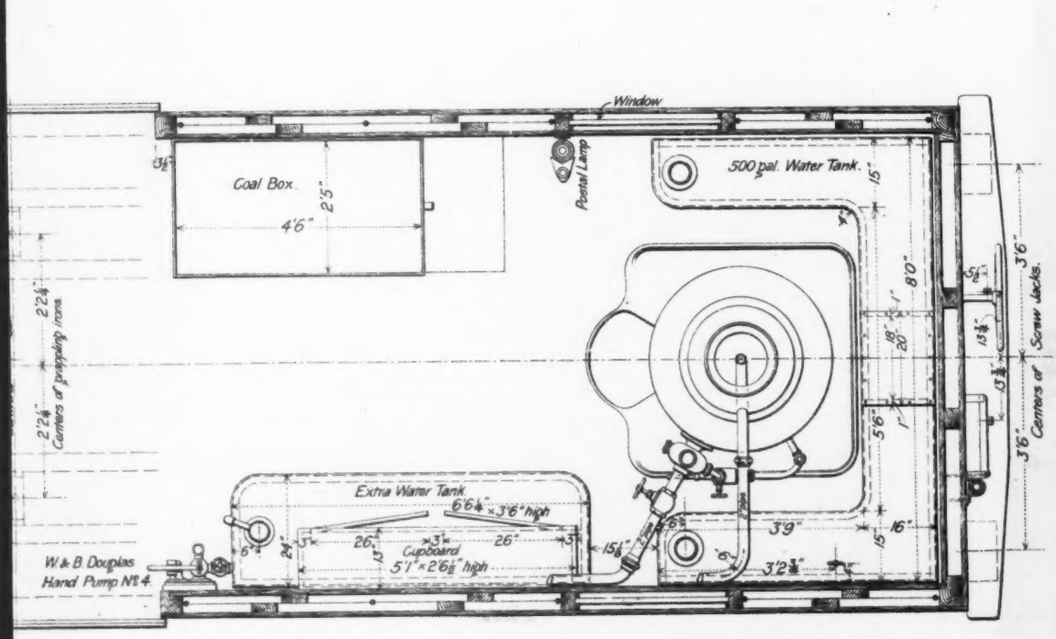


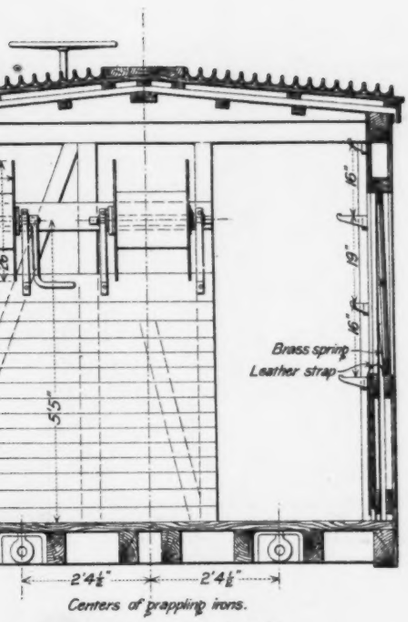
AN.

SUPPL

2 Reels of flexible wire 1,000 ft.
1 Reel of flexible wire 75 ft. long.
10 U. S arc lights, 2,000 candle power.
500 Carbons.
25 Poles.
12 Pole joints.
12 Pieces of ⅞ in. rope, 50 ft. long, for poles.
25 Porcelain carbulator knobs and screws.
10 Glass insulators with brackets and nails.
6 Cross-arm hooks.
1 Pick.
1 Crowbar
2 Balls of tape ¾-in. wide.
7 Jumpers.
5 Pair of line connectors.
1 Ball heavy twine.
1 Pair of vises and straps.
1 Pair of climbers.
2 No. 8 pliers.
2 Large screw drivers.
1 Hatchet.
1 Pole axe.
1 Cross cut saw, 26-in. blade.
1 Hard hammer.
1 Small soft hammer.
1 Large "
2 Hydrant hose connectors.
2 Commutator Brush wr'nch's
2 Cape chisels.
2 Flat chisels.
2 14-in. flat fine files.
2 14-in. ½ round coarse files.
6 Sheets emery cloth.

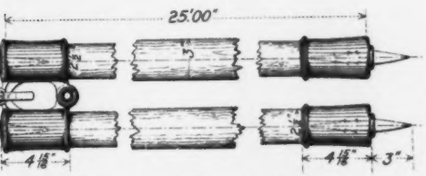
TRIC LIGHT CAR, PENNSYLVANIA RAILROAD.

THEODORE N. ELY, GEN. SUPT. OF MOTIVE POWER.



Centers of grappling irons.

TRANSVERSE SECTION.



IPOD FOR ELECTRIC LAMP.

SUPPLIES IN ELECTRIC LIGHT CAR.

wire 1,000
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6 " " paper.
6 Sheets sand paper.
6 White lamps.
2 Red "
2 Signal "
2 Postal "
7 Torches.
1 Broom
2 Red flags.
2 Green "
4 White "
1 3-gall. can crankcase oil.
1 2-gall. bucket " "
1 " cylinder oil
1 " Cooling Co. frt. dobe.
1 Qt. oil can for engine and dynamo.
1 Portable reel with 1,780 ft. of E. L. wire.
1 Tallow pot.
1 2½-gall oil can passenger engine oil.
1 2-gall. oil can signal oil.
2 1 " " castor oil.
1 12-in. monkey wrench.
1 Pipe wrench.
2 Solid wrenches, 1½ x 1½ in. jaws
1 S wrench, 1⅛ in. jaws.
1 4-in. Spanner wrench.
1 " monkey "
3 Safety plugs for boiler.
1 Safety plug cover.
3 Manhole plugs with lead joints.
1 Spiral spring for governor.
1 Pair flag holders.

2 Combination lamps.
8 Tin cups.
2 Balls candle wicks.
3 Postal lamp globes.
3 " " " wicks.
3 Torch wicks.
1 " tube.
1 Order book.
1 Funnel.
2 Glass water gauges.
1 Glass for Lubricator.
10 Lbs waste.
1 Sponge.
1 Funnel for filling tanks from stand pipes.
6 Class V No. 743 journal bearings.
4 Water buckets.
4 Screw jacks.
4 Blocks for jacks 3 in. × 6 in. × 2 ft. 6 in. long.
2 Cakes soap.
1 Box universal metal polish.
1 Box lye.
1 Scrub brush.
1 Fire shovel.
1 " hook.
1 " scraper.
1 Flue Blower.
1 Spanner for No. 4 injector.
1 Sponge bucket.
1 " hook.
1 " packing iron.
1 Flue auger.
50 Ft. ¾-in. hydrant hose.
25 Ft. 1½-in. hose for hand pump.
7 Straight poles.

CHAS. HART & SONS, LITH., 28 VESEY ST., N.Y.

be at once amended to require reports from every road which acts as a common carrier of both freight and passengers. The roads which do not now report are so few and unimportant that no hardship nor difficulty would result in closing this unseemly gap in the national reports.

The report for the first time makes known (barring a small "unofficial" mileage) the exact amount of double, triple and quadruple track, sidings, tunnels, trestling and bridging in the United States, these facts alone making it of unusual interest. The trackage stands thus:

	Miles.	Per cent.
Single track officially reported	143,949	100.0
Second " "	8,085	5.3
Third " "	722	0.5
Fourth " "	531	0.4
Sidings and spurs "	31,715	21.2
Total miles of track officially reported	191,001	127.4

The "unofficial" mileage of 7,810 miles, constitute 5.2 per cent. of the "official," and therefore, to these and the following figures 5.2 per cent. is to be added to obtain the probable total for the United States.

The "trestles" reported (presumably all wood, but not so stated, and, perhaps, including a few iron ones) number 117, 271 on the "official" mileage, of 26,615,877 ft. aggregate length. Performing some computations which should have been made for us in the report, with many others like them, we find that this gives a total length of 5,040.88 miles, or 3.36 per cent. of the entire mileage, the average length of trestle per mile being 177 ft., and the average length of each trestle 227 ft. There is about one trestle for 1½ miles of railway. It will be interesting and stimulating to good practice to see this proportion decrease year by year, especially if the figures be given hereafter for each State separately, as should by all means be done.

Similarly, the railway tunnels aggregate 649, of a total length of 608,012 ft., which we find to be 115.1 miles; the average length of each tunnel being 937 ft. The bridges on the official mileage (adding percentages) are alleged to be:

	No.	Per cent.
Wood	17,042	42
Stone	8,185	20
Iron	11,838	29
Combination	3,535	9
Total	40,600	100

Mr. COOPER, in his paper on "American Railroad Bridges" often noticed in these columns (Trans. Am. Soc. C. E. July, 1889), estimated only 162 ft. per mile of trestles in this country, and 3,030 miles of bridges and trestles combined, which is seen to be but little more than half the length of trestles only. His estimated totals showed 29,550 spans of iron only, which is not so very far out from the above total of 11,838 *bridges*, averaging presumably at least two or three spans each, but the amount of wooden bridging and trestling was seriously underrated; which we should add, worked against the argument which Mr. COOPER was endeavoring to make, so that he is to be credited for moderation. It is to be hoped that the commission will next year perfect its bridge record by giving us the number of spans and total length covered by its report of bridging.

The next point in the report of special novelty and interest, is a comparative statement of the track gauges of the United States in 1880 and in 1889, a curious and valuable table which we reproduce in full in another column, adding, as before, the summary which is needed to make the table comprehensible. The table at first glance makes a very bad showing for our intelligence as a people. It shows no less than 39 different railway gauges to have been in use between 1880 and 1889, viz.:

	No.
2 ft., 2 ft. 6 in., 7 in., 9 in., 10 in	5
3 ft., 3 ft. ¼ in., ½ in., 1 in., 2 in., 4 in., 6 in., 6½ in., 9 in., 10 in., 11½ in	11
4 ft., 4 ft. 1 in., 3 in., 7½ in., 8 in., 8¼ in., 8½ in., 8⅝ in., 8¾ in., 9 in., 9¼ in., 9½ in., 9⅝ in., 10 in., 10¼ in	15
5 ft., 5 ft. ½ in., 3 in., 6 in., 8 in., 9 in	6
6ft	1
8 ft. 4 in	1
Total of different gauges	39

Besides these, there are 5 different kinds of combined gauges, viz. 3 ft. and 4 ft. 8½ ins., and 9 ins. and 9⅜ ins.; 6 ft. and 4 ft. 8½ ins., and 4 ft. 9 ins. Moreover, while no less than 8 different gauges (besides 5 combined gauges) which existed in 1880 had disappeared in 1889, 18 new gauges had been added in 1889 which did not exist in 1880, so that on the face of the returns we have been working away from instead of toward uniformity, there having been only 21 different gauges in 1880 against 31 in 1889; a showing which will surprise almost every one, yet which is doubtless quite correct.

But on examining the summary, a very different showing results. In the first place there are 6 different guages of the list which are between 4 ft. 8 in. and 4 ft. 9¼ in. inclusive or differing only by 1¼ in., of which ¼ in. (due to 920 miles of so-called "4 ft. 8 in." track) probably arises from careless reporting, and the remaining ¾ in. (from 4 ft. 8¼ in. to 4 ft. 9¼ in.) is a legacy from the days of small things when 4 ft. 10 in. was deliberately adopted in Ohio with the idea of compelling break of gauge. All this mileage, therefore, may be regarded as practically one gauge, and is so operated, however much we may regret the needless trifling difference. Of this standard gauge track there is now 93.4 per cent. of the total, against only 82.7 per cent. in 1880.

The 3 ft. gauge, including 3 ft. 0½ ins., amounts to 6.1 per cent. against 4.9 per cent. in 1880, so that the standard gauge and standard narrow gauge tracks together (including also 0.1 per cent. of unreported) make up 99.6 per cent. of the country, leaving only 0.4 per cent., or 620 miles for the remaining odd gauges, 12 in all, or an average of 52 miles for each gauge.

Moreover, 3,474 miles of compromise (double gauge) track has wholly disappeared, indicating that exchange between different gauges is no longer necessary. There has been, indeed, an increase in narrow-gauge mileage, from 5,191 to 9,577 miles, but this mileage is controlled by 235 different companies, indicating that it is chiefly for local use on minor lines.

There is therefore real unity in this apparent complexity. The odd gauges are purely local lines for mining or lumbering purposes which have no chance for important conections, and most of these gauges are odd narrow guages, the one curious exception being 1¾ miles of 8 ft. 4 in. gauge, the purpose or locality of which very broad gauge we do not know. The table of gauges is shown in the next column.

The table of equipment does not differ very notably from Poor's in its totals; it shows on the whole rather larger aggregates, and is doubtless more complete; but it has the new and most interesting feature of giving the passenger, freight and switching locomotives separately, and also the leased and fast freight cars separately. It makes an unfortunate omission in not giving the total number of parlor and sleeping cars.

The locomotives are divided as follows, adding percentages as before:

	No.	Per cent.
Passenger	8,079	27.8
Freight	15,140	52.2
Switching	4,016	13.8
Unclassified	1,801	6.2
Total	29,036	100.0

It will be seen that there is about one switching engine for every four freight engines, in addition to which an immense amount of switching is done by road engines, illustrating how heavy an addition switching makes to the total cost of transportation.

An attempt is made to give the number of locomotives and cars fitted with train brakes and automatic couplers, but the statistics are for so old a date (June 30, 1889) that they have lost much of their value. Our own records come down to a much later date. Moreover, the report does an amazingly foolish thing, greatly decreasing the value of an otherwise important table, in "lumping in" freight and passenger equipment together in a table showing the number of each style of coupler in use. Separating freight and passenger cars as well as possible, the automatic couplers in use on June 30, 1889, over a year ago, stood as follows:*

COMPARATIVE STATEMENT OF GAUGE OF TRACK ON RAILWAYS IN THE UNITED STATES FOR 1880 AND 1889.

Gauge.	1880. No. Cos.	1880. Miles R. R.	1880. P. c. of total.	1889. No. Cos.	1889. Miles R. R.	1889. P. c. of total
			Per cent.			Per cent
2 ft.	1	18	.....	4	59	.....
6 ins.	.....	.....	.....	1	5	.....
7 ins.	.....	.....	.....	2	16	.....
9 ins.	1	1	.....	.....	.....	.....
10 ins.	.....	.....	.....	1	2	.....
3 ft.	144	5,191	4.8	234	9 485	6.00
¼ in.	.....	.....	.....	1	92	.....
½ in.	1	43	.....	.....	.....	.....
1 in.	.....	.....	.....	1	16	.....
2 ins.	1	25	.....	1	4	.....
4 ins.	1	8	.....	4	39	.....
6 ins.	13	307	.....	15	325	.....
6½ ins.	.....	.....	.....	1	8	.....
9 ins.	.....	.....	.....	1	12	.....
10 ins.	.....	.....	.....	1	10	.....
11½ ins.	.....	.....	.....	1	6	.....
4 ft.	.....	.....	.....	2	33	.....
1 in.	1	5	.....	1	7	.....
3 ins.	1	9	.....	1	56	.....
7½ ins.	.....	.....	.....	1	1	.....
8 ins.	1	6	.....	9	935	.....
8¼ ins.	.....	.....	.....	2	69	.....
8½ ins.	729	71,403	66.3	1,030	114,148	72.40
8½ ins. & 3 ft.	4	631	.....	.....	.....	.....
8⅝ ins.	.....	.....	.....	1	121	.....
8¾ ins.	9	1,925	.....	33	3,067	1.95
9 ins.	132	12,335	11.4	307	28,939	18.40
9¼ ins.	3	260	.....	.....	.....	.....
9⅜ ins.	.....	.....	.....	4	50	.....
9½ ins. & 4 ft. 9 ins.	1	110	.....	.....	.....	.....
9⅝ ins.	3	175	.....	.....	.....	.....
9⅞ ins. & 3 ft.	1	14	.....	.....	.....	.....
10 ins.	2	53	.....	.....	.....	.....
10½ ins.	2	20	.....	1	10	.....
5 ft.	91	12,282	11.4	2	22	.....
½ in.	1	20	.....	.....	.....	.....
3 ins.	.....	.....	.....	1	3	.....
6 ins.	2	128	.....	.....	.....	.....
8 ins.	.....	.....	.....	1	5	.....
9 ins.	.....	.....	.....	1	10	.....
6 ft.	16	259	.....	.....	.....	.....
6 ft. & 4 ft. 8½ ins.	2	2,808	2.6	.....	.....	.....
6 ft. & 4 ft. 9 ins.	11	35	.....	.....	.....	.....
8 ft. 4 ins.	.....	.....	.....	1	2	.....
Not given	.....	.....	.....	9	20	.....
Total	1,174	*108,070	.....	1,675	157,758	.....

*Miles of line, 87,801.42.

SUMMARY.

2 ft.	1	18	.....	4	59	.....
3 ft. to 3 ft. ½ in.	145	5,234	4.9	235	9,577	6.1
4 ft. 8½ ins. to 4 ft. 9¼	891	89,397	82.7	1,382	147,279	93.4
5 ft.	91	12,282	11.4	2	22	.....
6 ft.	16	259	0.2	.....	.....	.....
Not given	.....	.....	.....	9	201	0.1
Total of st'd gauges	1,144	107,190	99.6	1,632	157,138	99.6
Odd gauges	30	880	1.0	43	620	0.4
Total all gauges	1,174	108,070	100.0	1,675	157,758	100.0

Passenger cars:

Miller coupler	18,941
Janney "	5,968
Blackstone "	149
Cowell "	61
Janney-Miller	30
Miscellaneous or bull-noses (est d.)	516
Total passenger cars in U. S.	25,665

Freight cars:

Ames coupler	11,808
Janney "	11,568
Smillie "	9,413
Masks "	4,162
Blocker "	3,808
M. C. B. "	2,677
Huselton "	2,599
Safford (not an automatic)	1,729
McKeen " "	1,535
26 others (all under 1,000)	6,062
Total freight cars equipped	55,561

Of the above freight couplers one (the Safford) is not an automatic at all, nor anything but a somewhat improved bull-nose of the primeval type, and only 15,649 are of the M. C. B. type. Our own statistics, extending up to about Dec. 1, or five months later (ENG. NEWS Dec. 21, 1889), showed 56,050 cars equipped with M. C. B. couplers and only 15,755 equipped with other automatics, against 15,649 M. C. B. and 39,712 other automatics in the gov-

*By an inaccurate use of language the report states the table to give the number of each kind of couplers in use, when it is plainly the number of cars equipped with them.

ernment reports to June 30. Our reports were very complete, but erred by omission if anything for both types, so that there were probably at least 70,000 cars equipped with M. C. B. couplers on Jan. 1 of the current year.

The figures for automatic train brakes show 23,540 passenger cars (out of 25,665) and 104,619 freight cars to be equipped. Our own figures, published Dec. 31, 1890, showed only 85,365 cars so equipped, this total being extended by subsequent reports to over 100,000, but even the smaller figure showing about twice as many in use as any figures before collected indicated. As a matter of fact, however, it now appears that there were considerably more in use than even our reports indicated. Automatic train brakes and couplers have plainly come to stay.

It appears from the report that our locomotives are averaging the following tremendous duty, which we commend to the attention of our esteemed contemporary *The Engineer* in connection with the discussion we have lately had with it. For its convenience and our readers we add some comparative figures deduced from the Board of Trade returns for 1889:

	U. S.	U. K.
No. of engines in service	29,036	15,691
Av. train miles run per year per engine.	23,301	18,555
Tons carried per freight engine	35,643	†43,000
Ton miles per freight engine	4,538,786	*1,505,000
Passengers carried per passenger engine	58,444	†123,750
Pass.-miles per passenger engine	1,430,105	*891,000
Passenger earnings per passenger engine	$39,564	†$25,097
Freight earnings per freight engine	$42,588	†$28,734
Average earnings for all engines (incl. switching)	$33,228	$22,574

This comparison, while not precise in the items marked * and †, is beyond doubt, an essentially fair and accurate one. It shows an immensely greater efficiency *in* work, if not *for* work, for the American locomotive, while the comparative cost for running and maintenance may be shown by records to be much less than the difference in cost of labor and materials should call for.

Passing from the American locomotive to the American employé the contrast in apparent efficiency between him and his British brother is so great that even the commission are struck with it, and deviate from the usual practice in such reports by reproducing for comparison a table from the British official reports. To further facilitate comparison we combine these two tables into the single one given herewith, re-classifying the British table into the nearest American equivalent grades; and we add also, in the spirit of fairness which we always try to show, a significant line below the table showing the comparative revenue train mileage which may be regarded as the most important single item for a just comparison of this kind.

It will be seen that, keeping comparative train mileage in view, the contrast is much less than might be inferred from the extraordinary one (nearly 1 to 5) in number of employés per mile. The British railways require a little more and the American a little less than one employé per 1,000 train miles (one per 846 and 1,027 train miles respectively) and that is the end of the contrast. In other words, the real difference of efficiency appears to lie not in the men, but in the management; not in the labor taken to get a train over the road, but in the work accomplished by that train when it goes over it. There are minor *pros* and *cons* which affect this question both ways, but on the whole the face of the comparison is a fair one.

* In deducing these figures we have taken Mr. E. B. DORSEY'S figures for English average haul, viz., 7.2 miles for passengers and 35 miles for freight, on each passenger or ton carried, these figures having been accepted by various English authorities as substantially accurate.

† In deducing these figures we have divided the total of British locomotives, 15,691, as follows:

Estimated passenger engines	6,000
" freight "	6,555
" switching and miscellaneous (1-5)	3,136—15,691

The switching and miscellaneous engines have been estimated large in order that the average for the road engines shall not be unduly reduced. The division between passenger and freight engines is made so as to correspond as closely as possible.

NUMBER AND DISTRIBUTION OF RAILWAY EMPLOYES, UNITED KINGDOM AND UNITED STATES.

Class of Employés.	United Kingdom. No.	United Kingdom. Per 100 miles of line.	United States. No.	United States. Per 100 miles of line.
General officers	.....	.....	4,739	3
Gen. office clerks	.....	.....	20,817	13
Station agents	6,165	31	24,171	16
Other stationmen	41,809	211	58,037	38
Enginemen	12,874	65	30,217	20
Firemen	12,795	64	31,993	21
Conductors	15,369	77	20,953	14
Other trainmen	.....	.....	55,160	36
Machinists	55,940	282	25,214	16
Carpenters			33,244	22
Other shopmen			75,959	49
Section foremen	37,840	191	25,539	17
Other trackmen	70,405	355	145,401	95
Switchmen, flagmen and watchmen	26,878	137	33,044	21
Telegraph operators and dispatchers	.....	.....	16,937	11
Employés—floating equipment	.....	.....	6,998	4
All other employés	62,833	317	80,080	52
Not distributed	3,518	18	16,240	11
Total	346,426	1,748	704,743	459
Comparative revenue train miles	291,197,134		723,772,142	

We should note also that the report is most improperly careless in language in speaking of this table throughout as showing the employés on "English" railways, when it shows, in fact, all there are on British railways, *i. e.*, English, Scotch, Welsh and Irish. Such confusion of terms may be pardonable colloquially, but is not pardonable officially. So complete is the obscurity, and so unusual the misuse of words that it was necessary for us to refer to the original reports to be sure which was intended.

The remainder of the report of the commission contains some very interesting matter in regard to the organization of railways which it is quite impossible for us to notice properly this week, and which we, therefore, will not notice at all until a following issue.

Sewerage Systems in the United States and Canada.

Good sanitary engineering demands that a city or village having water-works should also have a sewerage system. Those who have considered the matter know that but few cities introduce these public works at the same time and that many towns now sewered had water-works for years before their sewers were built, and that in hundreds of villages and cities a general supply of water has been introduced, while not a mile of public sewers has been constructed.

No general data have been published heretofore regarding the number and character of the sewerage systems in this country; therefore it will not be out of place to include here some information regarding this important branch of engineering.

The data presented herewith has been very kindly furnished us by the water-works officials of the country, and will be found in detail in connection with the descriptions of the various works in the body of the MANUAL OF AMERICAN WATER-WORKS. As there cannot be sewerage systems where there are no water-works, we have confined our inquiries to the towns having the latter, requesting from each a statement as to whether they had a sewerage system.

Of 1,960 water-works in the United States, 1,366 have replied to our inquiries, and their answers are summarized for groups of States and the United States in Table S, as are also the replies for Canada. The 594 works in the United States and the 22 in Canada for which we have no data are mostly in small towns, over a third of which have had water-works only since 1889, and very few of which have sewerage.

Of the 1,366 works included in the table, 466 report sewers, 84 report that the town is partially sewered, 25 that a sewerage system had been projected, and 816 that the town is entirely without sewers.

The total number of towns in the United States for which either a sewerage or partial sewerage system was reported is 550. We doubt if anywhere near 10 per cent. of those towns for which no report was given have sewerage, but even if there were 50 such we would have but 600 sewerage systems against 1,960 water works.

TABLE S.

SEWERAGE SYSTEMS IN THE UNITED STATES AND CANADA —BY STATES AND GROUPS OF STATES.

Group	Sewered.	Partially sewrd.	Without sewers.	No. reporting.	Total No. of Sewers water-w'ks.	Sewers projected.
New England	85	14	132	231	325	4
Middle	117	24	184	325	509	2
South Atlantic	16	2	39	57	92	3
South Central	19	2	23	44	71	0
North Central	106	25	153	284	377	9
Nort western	58	9	138	205	268	3
Southwestern	28	4	83	115	152	2
Pacific	37	4	64	105	166	2
United States	466	84	816	1,366	1,960	25
Canada	26	8	31	65	87	1

Canada makes a much better showing, with 26 towns sewered and eight partially sewered, or 34 out of 87 having water-works. But Canada has been backward in the introduction of water-works, and as those built are in the larger cities we would naturally expect to find that a greater proportion are sewered.

It will be seen that the Middle and North Central groups show a large number of towns partially sewered. Doubtless many other towns, both in these and the other groups, would properly come under this head, but we have summarized them as reported.

Of course, many of the villages and cities which are now without sewers are small and not compactly built, but it is often true that such places have an unlimited supply of water, or at least use large quantities, and in any case the continual use of cesspools cannot fail to be a menace to health. But the towns without sewerage are not all small, there being 61 in the United States with an estimated population of 10,000 or over. Of this number 33 have a population of from 10,000 to 15,000; 10 of 15,000 to 20,000; 7 of from 20,000 to 25,000; and 11 have a population of 25,000 or over.

The names and populations of the latter, ranged according to size, are as follows:

Dayton, O.	55,000	New Albany, Ind	30,000
San Antonio, Tex.	45,000	Austin, Tex	27,000
Mobile, Ala.	40,000	Auburn, N. Y.	26,000
Knoxville, Tenn.	40,000	Lexington, Ky.	26 000
Galveston, Tex.	40,000	Joliet, Ill.	25,000
Houston, Tex.	34,000		

It is probable that some of these might have been included under the head of partially sewered, but none were so reported. Austin, Tex., it is said, has two miles of private sewers.

Of these 61 towns 48 have had water-works since 1885, 22 since 1875, 7 since 1860, 5 since 1850, and 1 since 1799. For all these years cesspools and open drains have been used, and the soil has been filling with impurities. In view of this, it is indeed a wonder that a pestilence does not break out in many an American city. The death rate in nearly all our cities is far larger than it need be, but who can tell how much it might be reduced in the unsewered cities, and to what enormous height it may arise in any particularly unhealthy summer?

It is probable that nearly all of these 61 cities, and many of the smaller ones without sewers, as well, could raise the money necessary to put in a system if the general apathy regarding the subject could be overcome. True, municipal expenses are increasing at a rapid rate all over the land, but sound financiering and judicious management of public works would make possible many improvements now thought to be beyond reach.

All but four of these 61 cities have their streets lighted by electricity, and nearly all were lighted by gas when the electric lights were introduced.

The entirely new capital required for electric lighting upon which interest has to be paid would have gone a long way towards establishing sewers, at least in the most densely populated sections.

All but 19 of these cities have no water-debt, as their works are owned by companies; so heavy interest on water bonds cannot be one of the excuses for not putting in sewers. What, then, is the reason? Of course we can only conjecture, but it seems probable that in most cases the people do not yet realize their present unsanitary condition, and besides, the taxpayers are doubtless against expenditures for the construction of sewers. In addition, some towns have already reached, or nearly reached, the limit of their bonded indebtedness, and they need many public improvements besides sewerage. Another drawback is that special legislation is required in some States before a city can issue bonds for any purpose.

Most American villages and cities of importance are already supplied with water, but we have seen that large numbers are yet entirely without sewerage, while many of those reporting sewers have hardly taken the first step toward providing an adequate system. Here, then, is a wide field for our engineers, but one requiring hard and often unappreciated labor to develop.

Notes Abroad—In Greece and Egypt.

[EDITORIAL CORRESPONDENCE.]

CAIRO, Egypt, July 24, 1890.

As the result of a sudden change of plan in Athens, made after a season of oppressive heat and dust-blinding siroccos in that city, had caused an African sun to loose much of its terrors, my friends and myself determined to sail for Alexandria, and from there make such a tour through Lower Egypt as the time at our disposal would permit. So far in our experience we have seen little of engineering interest which is not already familiar to the readers of ENGINEERING NEWS, but the following hasty notes of a too-hasty journey through little visited regions may have some grains of interest.

In Greece we passed over the Corinth Canal in a railway train; but even in that flying inspection saw enough to warrant the present suspension of work until further funds are raised to slope the sides of the excavation. Generally the work appears to be in excellent shape, but the almost vertical cut shows a decided tendency to slip in places and it will require a large outlay of capital to make the canal a safe means of transit between the Gulf of Corinth and the Ægean Sea. The plant on the ground is well cared for and apparently ample, and, if the rumored success in raising a new loan in Paris be correct work can be resumed at short notice.

Athens, as a city, was very disappointing. It is new French, glares under the July sun, and dense clouds of blinding white limestone dust covers the city and everything in it at this season of the year. A visit to the Acropolis and the few other remains of ancient Greece, and to the wonderfully interesting treasures of Mycenæ and Troy gathered by Mr. SCHLIEMANN, covers the points of real interest there. Aside from their intense historical interest, the Parthenon and the Temple of Theseus called forth our admiration for their exquisite structural finish and the thoroughly honest workmanship of the artisans and artists of twenty odd centuries ago. Thanks alone to Venetian, Greek and Turkish cannon and to the questionable taste of Lord ELGIN, the Perthenon is now only a superb ruin with battered and fallen columns and despoiled frieze and facade. Studied from the builders' standpoint these remains show that the walls and columns were laid stone to stone, with polished faces of contact so true that in many cases the joints between the massive blocks of Pentelican marble would scarcely admit a sheet of paper. The fallen columns show that the beds of the sections were first worked with a toothed tool, leaving a mark exactly similar to that used to day. But for about 8 ins. inside the fluted circumference the marble is as smooth as glass, and these polished faces were evidently the true planes of contact and bearing. Careful examination of wall and column failed to reveal any trace of any kind of cementing material; and in the columns a wooden plug about 4 ins. square alone provided against lateral movement. As buildings these temples would doubtless have successfully resisted the tooth of time for centuries to come. Man and his wars have brought them to their present state.

At Alexandria we had our first practical experience of Eastern life and methods in our landing. The steamer anchored in mid-harbor, and the traveller and his luggage must be transported ashore in some one of the native boats that swarmed about the incoming vessel. The Arab boatmen board the vessel much after the manner of their piratical brethren of Algiers, and the tourist is at once surrounded by a howling, grabbing mob, and deafened by a very Babel of tongues; each one of the ragged but picturesque pirates is determined that he will bear off his prey to the shore, regardless of any individual preference in the traveler, and whole or in fragments, as Allah may will it. It is here, more than anywhere else in Europe, that the advantages of Cook's tourist agency became apparent. Bewildered and exhausted in our efforts to understand and be understood, we hailed with joy a cap announcing its wearer as a commissionnaire of Thos. Cook & Son, and engaged him at once to pilot us out of the turmoil. After that all was well; we were comfortably set ashore; passed through the custom-house, with a few piastres substituted for an examination of our luggage, and finally set down at our hotel. This is a free and voluntary "ad." for the Messrs. Cook, granted in grateful remembrance of real service rendered to be-deviled Yankees.

Our stay in Alexandria was very short; for, like Athens, it too is a comparatively new and Europeanized city, with little more than Pompey's Pillar and the *site* of the obelisk that now adorns Central Park to redeem it. We almost immediately departed for Cairo, the real objective center of our summer pilgrimage.

I would first note that the Delta, or Lower Egypt, is triangular in shape, with its apex about Cairo and a base of 150 miles on the Mediterranean Sea. What may be called the perpendicular of this triangle is about 125 miles long. The Nile created and the Nile preserves this exceedingly rich and fertile section of Egypt, and without this life-giving river the whole country would soon be little if any better than the parched Arabian and Lybian deserts that bound it on either side and lie beyond the influence of its fertilizing flood.

The annual rainfall at Cairo is about 1⅛ ins., and at Alexandria it is only 8 ins. With these climatic conditions, and in view of the wonders wrought by the muddy waters of the upper Nile, it is not remarkable that the ancient Egyptians deified this river and worshiped it as a god.

A summer excursion to Egypt is not to be generally recommended, but it has its compensation, for we saw the Delta in its busy season, with the fields in part covered with growing crops; with the grain in other cases being cut and threshed out, and with the Nile on the rise and one-third way toward the 28-ft. mark of "High Nile." The *fellâh*, or Egyptian peasant, was busy with every variety of water-lifting device invented before and since the time of the Pharaohs, in transferring water from the main irrigation canals, that everywhere thread the Delta, to the lesser channels leading to the fields to be flooded for coming crops. Caravans of camels, looking like great turkeys in the distance, passed along the dykes, and carried on their backs great sacks of dried Nile mud; everything was alive, presenting a scene that only Egypt can present, and constantly recalling all that we had ever read of Eastern life or Biblical antiquity.

Egypt in its agricultural methods is conservative and slow, and it is not a too wild stretch of the imagination to assume that JOSEPH and his brethren gazed upon a scene much the same as that which lay along our path. Nothing could be more primitive than the house of the Egyptian peasant, with its walls of bricks made of Nile mud and chopped straw, fashioned as the oppressed Israelites made them, and suggesting a colony of mud-wasps in the promiscuous manner in which the houses are plastered against and on top of each other. His dress is generally a single garment, and often none at all, and many of his tools are certainly as old as Egypt, and figure, almost unchanged in form, on some of the earliest of Egyptian monuments. As beasts of burden he has the same camel, buffalo, ox and donkey, and his methods of reaping his crops and treading out and winnowing his grain are all on record in prehistoric sculpture.

While the Nile floods some portions of the dyked fields, other sections must have the water lifted to their level, and the latter is generally the case at this season. In our trip around the Delta I believe I saw about every water-raising device now in use here, and a list of these would be about as follows: The most important and common is the *sakiyeh*, or water-wheel. This is a huge, upright wheel, very rudely framed and turned, through a clumsy, pegged gearing, by buffaloes, oxen or camels. In one form the wheel is provided with boxes that lift the water from a lower channel and pour it out again into a trough when it has reached the highest point of the wheel. In another form, earthen pots fastened with straw rope take the place of the boxes; and for a lift exceeding 20 ft., the usual diameter of the wheel, an endless chain of pots passes around pegs in the rim of the wheel. The *shâdûfs* is probably the most ancient appliance of all; it is practically the old well sweep of the Saxons, working between two pillars of Nile mud with the pole counter balanced with a perforated stone or a lump of dried mud. The basket attached to the end of a rope of hide or twisted reed is filled from a well communicating with a main canal and is then lifted and emptied into a channel of higher level. Another common device for low lifts is simply a basket that is swung between two men by means of four ropes, two on a side; it is filled and then swung up and emptied by one motion. In other places we saw a crude Archimedean screw used for a lift of about 2 ft., and at very rare intervals steam pumps of French or English make were pouring out a stream that would have drowned out a dozen or more of *sakiyehs*. But fuel and engineers are too dear, and bullock and human labor too cheap to encourage any rapid substitution of Frankish machinery for the time honored Egyptian methods.

The fertile soil of the Nile seems to need little provocation in the shape of breaking up of the surface, and the plow and the hoe in common use do little more than scratch the top soil. The plow is a pole about 6 ft. long with a straight single handle at one end to guide it and a plow share made of a piece of wood set at an angle and shod with a small piece of iron. It is pulled by a pair of oxen with a horizontal pole lashed to their horns, or even by men. The hoe is a rude adze-shaped affair with a handle about 2½ ft. long set at an acute angle to the blade. The grain is cut by a sickle or even pulled out by the roots; it is tramped out by oxen pulling a heavy wooden sledge mounted on rollers armed with semi-circular iron teeth, and the winnowing is done by preparing a piece of ground and then patiently tossing the crushed stalks and ears into the air in a breezy place, and finally passing the remainder through a sieve. As before said, every process is of the simplest character, and they seem to have passed down from the remotest antiquity without change. When we saw the fellahs at work building new dykes or deepening old canals, the dirt was removed in baskets on the heads of men and women, and the masons were supplied with building stone in the same manner. As we saw him, the Egyptian peasant seemed a hard-working, patient fellow, with little or no future, and with present filth and misery to any imaginable degree. Under his old masters his constant toil just paid his taxes and kept the life in his body; and we could not see that his condition was materially changed under the present Anglo-Egyptian rule.

Cairo itself must be seen; it cannot be described on paper. With its narrow, crooked streets and quaint Eastern architecture, its bazars and ruined mosques, its richness in color and endless variety in dress and novelty in street scenes, every nook frames a picture that canvas might partially convey to those who have not seen it, but words fail utterly. With these surroundings and in this atmosphere all that we have ever read of Eastern life, in history or in fiction comes back to us, and even now, in many sections, time ceases to be a factor, and we realize that what we see "was always thus." The Moslem here does not repair; if a mosque or minaret tumbles down "God wills it" and that is sufficient for his faith. As an example, we visited the mosque of Sultan Hasan, built about A. D. 1356, and at one time the finest existing monument of Arabian architecture. It is still used for worship, but the wide wooden frieze that once surrounded its main hall, with its one-time gorgeous carving, gilding and green paint and curiously intertwined Arabic char-

acters, has fallen in some places and in others bulges out to a dangerous degree, threatening to fall at any moment on the heads of the Mahometans below. The roof is shaky and the mosaic pavement of precious marble is a wreck, but it is Kismet, it is fate and the believer would not change it. But in anticipation of this fate they build new mosques and opposite the dilapidated mosque of Sultan Hasan another is being erected with money provided by the grandmother of the present Khedive. The construction is being carried on with extreme deliberation, as is all native business in Egypt, and if the old mosque does not yield too soon to its aggravated attack of old age the new one will probably be ready to replace it. D. McN. S.

[*To be Continued.*]

CORRESPONDENCE.

A Circus Train Accident.

LITTLETON, N. H., Aug. 15, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: An accident occurred near this station yesterday (Aug. 14), about 5:45 P.M. on the Concord & Montreal R. R. It was a head collision. An extra passenger train from a circus had just left this station, ran one quarter mile and stopped with part of the train on a bridge. While a man was running ahead to turn a switch for them to run out on a siding, the regular passenger train, a few minutes late, ran into them. The locomotive that was at rest was injured but little, while the one that was in motion had the smoke-box door smashed in and the cowcatcher and forward truck taken off. The only person injured was the fireman of the locomotive at rest, who jumped and hurt his head. R. T. G.

[This is one of a large class of accidents which do not get into the daily press at all. It has been nowhere else reported, and is another evidence of the exceptional dangers which beset special trains.—ED. ENG. NEWS.]

The "Affiliation" Question.

ENGINEERS' CLUB OF KANSAS CITY,
FORT SUPPLY, Ind. Ter., Aug. 10, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR:—Though uncertain in what way it will be brought about, the discussion now going on concerning the affiliation of our engineering societies is not likely to be without result. So far, most of the schemes proposed affect a portion only of these societies, and do not consider the result on those remaining, whether on our three or four national societies, to the American Society of Civil Engineers, or to the local societies alone. Now, it seems to me that any immediate change made in this direction should at least take into account the future of every engineering society in the country. Not that provision should be made to admit all in a general federation, but that the opportunity should be left to do this to such an extent as may be thought best hereafter.

And as a matter of expediency I think the desired end may be best brought about by successive steps, having in view always such action as it may be desirable to take in the future.

In the first place, as the local societies will, perhaps, be affected most, and as it would facilitate any action to be taken between these and what may be called the "national" societies, it would seem best to strengthen the bond between these in various ways. This can be readily done by co-operating with the Association of Engineering Societies, which already includes all but three or four of the more important local societies, in such ways as regulating the conditions of membership, publication of papers and providing for the transfer from one society to another on change of residence, a movement that has already been favorably reported on by a number of the local societies.

Nothing will be lost by this action, which is very desirable in itself, whether affiliation with the American Society takes place later or not.

Secondly, as proposed by a recent committee of the "Association," the American Societies of Civil, Mechanical, Mining, and Electrical Engineers might be connected in such a "Federation" as would enable them to co-operate in the various ways, such as the establishment of standard units, tests, etc., a code of professional ethics, a national engineering library, the entertaining of distinguished foreign engineers, etc. It can easily be seen that such a union would be of great influence, representing all that is best in American engineering practice, and that in the formation of one great library and engineering museum a considerable economy would result, without interfering in any way with the conduct of the individual societies.

Having these two questions settled (concerning the National and local organizations), the American Society of Civil Engineers could then more easily make such revision of its constitution as might be thought best; as, for instance, to the qualifications, salaries and election of officers, the establishment of local chapters, etc.

By this time some scheme for the affiliation of the local societies, either with the American Society or the proposed Federation, could be more readily made and, I think, would be acted upon, enabling all engineers to join where co-operation is desirable, and allowing sufficient freedom for the individual action of each local society.

K. A.

Highway Officials and Highway Maintenance.

SYRACUSE, N. Y., Aug. 18, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

You certainly have my sincere thanks for the reference to the work of this association, and my own part therein, in your issue of Aug. 16. I note with much pleasure that you say if addresses are furnished you will send out Herschel's Prize Essay on the Science of Road Making, which is almost as complete a paper as there is on the subject, free to the highway authorities of the State. With my experience in collecting data from them, however, I should certainly say this would be almost "throwing pearls before swine," for with but four exceptions (after expending $40 for stamps, and typewriter has expended 3½ months' of an expert shorthand writer's time on this subject) we have received back from this class of people no encouraging word on the subject. Many of the Town Clerks will not answer our communications at all, and even the supervisors of Onondaga Co. (19 in number), each and every one, have refused to join this association, or answer any of our communications. We have also written to the treasurers and assessors of the cities and incorporated villages of the State of New York—to some we have written twice and many three times—simply to get the assessed valuation of the city or village, as we were desirous of showing to the farmers of the State of New York that under the RICHARDSON Bill (that there should be expended $3,000,000 or more for making good, first class macadam roads from county-seat to county-seat, the money being taken from the general fund of the State) at least 85%, if not 92%, would come from the tax-paying people of the cities and incorporated villages. We have worked faithfully for this, now 3½ months, and have not got them all yet; but we have got enough to show that over 90% would be paid by the cities and incorporated villages of the State. It certainly ought to be self-evident to any one that, were this money taken from the fund and expended upon the roads under that bill, the benefits to be derived would be largely, or practically we can say all, received by the farming community; that the money to be expended could be earned very largely by the agricultural part of the community in digging stone, and transporting all sorts of material; and yet with all this it is with humiliation that I write to you that absolute indifference seems to prevail among those now in charge of the roads of this State. We have a very good letter, indeed, from a gentleman in Washington, Westchester Co., where he has had charge of the roads for seven years, showing the results which he has attained, and some others like it.

ISAAC B. POTTER, Potter Building, is Secretary of this association in New York. Just when and where the next meeting of this association will be called, I do not know, but I trust it will be at an early day, and that you will have one of your reporters on hand at that meeting. Hon. ISAAC B. POTTER, Potter Building, New York, is secretary of the association.

HERSCHEL'S essay is a remarkably good one upon the subject. I think he does not go far enough, however, in discussing the causes which destroy a good road. He speaks of the width of tires; that it should be considerable. I agree with him, practically, in that, but I go farther. There should be established a width of trackage of the wheels. In a wagon to carry 5,000 to 6,000 lbs. the fore-wheels, we will say, should not exceed 3 ft. 10 ins. on the outside measurement, while the hind wheels should be 4 ft. 6 ins. The hind-wheels should always be the width of the tires and one inch besides wider, or farther apart, than the forward wheels so that they should *never track*. If they never track they will never rut the road, and a road once even and true will be always even and true. In a wagon that should carry 6,000 to 8,000 lbs. I would have the fore-wheels a little wider than the fore-wheels of the lighter wagon and the hind wheels as much wider in proportion, adding to the width of the spread of the hind wheels always the width of the tire and one inch besides on each side. In this way the fore-wheels of the wagon that carries 5,000 to 6,000 lbs., and the one that carries 7,000 to 10,000 lbs., would never track in each other, and the hind wheels would never track with any other; consequently, if you should drive over a road used by such a system of wagons you would cover a width upon the road of about 20 ins. on each side, instead of covering a width of only about 3 ins. on each side, as is now done with the farming, country and stone wagons. The consequence is that even with the best piece of macadam road I have ever seen made in this country, if there were one hundred stone wagons to ride over the road, all being of the same width, you would have ruts in the road that would hold water in the first rain that came. Then the little hollows would be softer the next day than the little ridges; the wheels would slip into them, and go on increasing the depth of these little ruts until you had your road rutted completely from end to end. This is what destroys good roads. I was led to this train of thought by driving around the corners on country roads. *I never yet saw the corners on a country road rutted*, and I do not believe that any one else ever did. The reason is, because no two men will turn around the corner of a road exactly alike; the hind wheels will never follow, because the wagons are geared different lengths from the front to the hind wheels, and hence all roads are smooth around the corners.

There is another cranky motion on road making which I am advocating, and that is, that no road should be made rounding in the middle, but should always be made inclined, either to one side or the other, and as straight and as smooth as you can make it sidewise. Make the roads in this way and have a law passed that the wagons shall be made with the width of the tires as designated in HERSCHEL'S essay, and that the wheels shall be made different widths of trackage, as I have suggested, and 90% of the road making of the State of New York is done.

WM. A. SWEET,
President New York State Roads Improvement Association.

A Defense of the Burton Electric Heater.

RICHMOND, Va., Aug. 15, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In an article in your issue of Aug. 9, on "the Production of Heat from Electricity," occurs the following passage:

"Among the numerous lines of impracticable inventions referred to above is the production of heat from electricity. We do not now refer, of course, to the class of inventions which utilize the electric current for heat for special uses, as the welding or smelting of metals, the heating of various instruments, etc., but to the numerous schemes for warming buildings, cars, etc., by the electric current. That this is not only theoretically but practically possible is, of course, true; but the commercial test is the one by which an invention must stand or fall, and by this test the electric radiator is at once seen to be nothing more than a scientific toy."

In order to apply the "commercial test" to the Burton electric heater, the Burton Electric Company caused a series of the most exhaustive tests to be made last summer by a thoroughly competent electrical engineer. A suitable room and electrical measuring instruments were provided for this purpose, and the current was supplied by an Edison 220-volt dynamo. In his report the electrical engineer says:

"The resistance of the heaters was first carefully measured. They were arranged in two sets on the floor of the room, to represent their relative positions on two railway cars. Set No. 1 consisted of 15 heaters in series of three and set No. 2 of 14 in series of two. Their joint electrical resistance was found to be 6.77 ohms. The current was then sent through these two sets and the deflections on the voltmeter and ammeter noted. The readings were as follows: Voltmeter (reduced to volts), 190; ammeter (reduced to ampères), 28.48, or equal to 7.251 electrical horse power."

"From the increased temperature of the room during these tests, my opinion is that a 45-ft. passenger coach can have its temperature raised at an expense for coal of one-sixth of one cent for each degree Fahrenheit, within the limits required in practice. These calculations are based on the use of coal at the same price as is now paid by the electric light companies of this city, and on machinery of equal efficiency. The cost of maintaining the temperature of a car, once heated to the desired temperature, should not exceed for coal consumed more than 3 cts. per hour per car."

The next step to prove more conclusively the commercial value of the Burton electric heater was to obtain a regular passenger coach and continue these tests. This coach was furnished by the Richmond, Fredericksburg & Potomac R. R. Co., and in it were placed 14 Burton heaters, having a radiating surface of 70 sq. ft. Wires were run into the car through one of its end windows from the power station on Seventh St., and a switch was provided for letting on or cutting off the current. The main object of this test was to demonstrate that by the use of a powerful current for a short time only—the plan in use by the Burton Company in warming electric cars and covered by a patent—a car could be heated to the desired temperature more quickly than by any other known method; and the next was to show that this temperature could be maintained as cheaply as the present method of warming railway cars.

After having measured the use of current in this test, the same electrical engineer reported that the expense, represented in the use of coal, of heating this car to a difference of 35° Fahr. above the outside temperature was at the rate of 12 cts. per hour, or 6 cts. for half an hour—the limit of time it was proposed to take to warm a car by this extra use of current. He also estimated that this temperature could be maintained by the use of less current, at a cost in coal burned of from one-half to three cents per hour.

Whether these tests were absolutely correct or not, they go to prove that where steam power is used in the production of electricity, the cost of operating the Burton electric heater lies in the coal burned at the generating station.

Neither the Burton Company nor the inventor of the Burton heater make any claim that their heaters can be applied to the warming of steam passenger cars, for the

reason that, so far, no device has been perfected for producing the necessary current while a train is in motion. Neither do they claim that buildings could be economically warmed by them in cases where the usual profit is charged by electrical companies for the supplying of the current at the rate of so much per electrical horse power. But they do claim that they can be used to the greatest advantage on electrical railway cars where the cost of the current used is represented in the coal burned at the generating station. This, in fact, is what the Burton heater claims to be—an electric heater for electric railway cars; and as far as proofs of its efficiency in this direction may be concerned, actual tests on electric railway cars in different parts of the country have caused it to be highly indorsed by the parties making use of it. One testimonial from Massachusetts says: "We shall continue the use of your heaters hereafter on our cars, as the heat is pleasant, sufficient and economical." Another from St. Louis says: "We are much pleased with them, and know of no reason why we shall not continue to use them and recommend them to others."

With such indorsements of the Burton electric heater after actual trial, it is left to any candid mind to decide whether it has not a higher claim than that of being "a scientific toy." W. LEIGH BURTON.

[Heating electric street cars may properly come within those special uses which we expressly excepted. Economy of fuel may be of minor importance compared with convenience and saving of space; but we look in vain in the above communication for any statement of the actual efficiency of the heater above described in heat units generated per pound of coal burned at the central station, a point of more practical interest than a dozen estimates and opinions concerning the cost in cents per hour per car, under unknown conditions, as regards inside and outside temperatures, cost of coal, etc. In the article which our correspondent criticises we estimated 872 H. U. per pound of coal as about the best possible efficiency of an electric radiator. If he has succeeded in getting any better results than this, we shall be pleased to learn it. The inexorable laws of thermo-dynamics will prevent him from doing very much better; and we are inclined to believe that the efficiency of a radiator taking current from the line wire of an electric railway would not be more than 500 H. U., there being some 14,000 H. U. or more in good coal. While this is only one-twenty-fifth or less of the total heat contained in the fuel, it is doubtless a "very good heat, what there is of it."

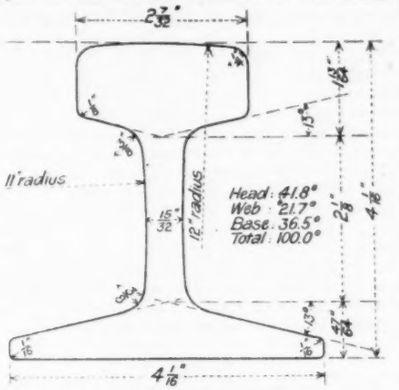
Of course, as we have stated, if there is any especial objection to the use of the common methods of heating, which are much more economical as regards fuel, the electric radiator may be commercially practicable in cases where not much heat is needed. For an electric railway using cheap coal and with plenty of power to spare, especially if located as far south as Richmond or St. Louis, it is quite possible that the extra consumption of fuel might not be felt much at the power station. There is undoubtedly a field of some extent here which an electric heater may hope to capture, as also where an electric current is already at hand and the amount of heat required is small.

But we are unable to see that the so-called test with the full size passenger car proved either of the two things for which our correspondent says it was intended. He is seemingly infected with the still prevalent idea that there are great obstacles to heating cars by steam from the locomotive. As he does not say either how long he took to heat up the car or to what temperature it was heated, no reference need be made to the work which the perfected steam-heating systems can accomplish; but no railway official need delay the introduction of steam heat to his cars under the belief that the electric heater is soon to displace steam heat. Of course, when a process is discovered for producing electricity direct from the heat, the electric heater may be expected to displace stoves and radiators everywhere; but when that discovery is made, the locomotive itself will go too, and speedily.—ED. ENG. NEWS].

New 56-lb. Rail Section.

The accompanying illustration shows a new light rail section designed last year for the Chicago, Burlington & Quincy R. R., of which considerable quantities have been rolled since. To our thinking it is a nearly perfect rail section for such a weight, and likely to give most excellent wear. It will be seen that the head and base are of nearly equal mass (41.8 and 36.5%), the web being fairly thick, as it should be. The total height of the rail is the same as width of base, and is the same as that of the old standard C. B. & Q. rail, while this section is also designed so as to take the same angle-bar as the C. B. & Q. standard 66-lb. rail.

The head will be seen to conform to the recommendations of the late Am. Soc. C. E. committee on form of rails, viz., 12-in. top radius, ¼-in. corner radius, vertical sides, and broad head relatively to depth. It differs from them, however, in using a



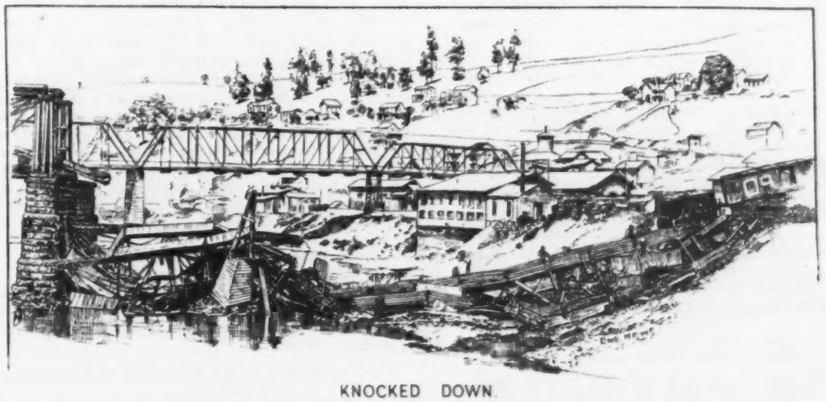
New 56-lb. Rail Section, Chicago Burlington & Quincy Railroad

⅛-in. instead of a 1/16-in. lower corner radius for the head, and in our opinion without good reason, the angle-bar bearing being thus diminished without any contravening advantage; for, if 1/16-in. corner radii can be used for the base without disadvantage in rolling, they certainly can be used for the head.

The form of the base is worthy of particular note. There are objections either to sharp corners at the extremities (from tending to cut into the ties), and to semicircular curves from not giving bearing enough on the spikes. The 11/16-in. radii connected by a tangent seem just the proper compromise. The nearly vertical sides of the web are also in the direction of good practice, and the large fillet radii. It is an open question just what these radii should be, since to make them too large injuriously diminishes the angle-bar bearings, but convenience in rolling demands that they be as large as possible.

Knocked Down.

The accompanying engraving is from a photograph of an accident on the Baltimore & Ohio R. R. near Grafton, W. Va., on Aug. 3. As a fast freight train was pulling out of the station on the morning of that day, a car near the middle of the train jumped the track and struck the end-posts of the structure, which was an old through Bollman or Fink truss across Tygart's Valley River. The span at once collapsed, and seven cars followed it into the river. One track hand had a leg broken; no other person was on the wrecked cars. The engine and several cars behind it passed over in safety.



KNOCKED DOWN.

Among the wrecked cars was the tank car seen near the left abutment. This was full of crude oil, which was at once spilled into the river and there set on fire in some way, the fire raging below the bridge for over an hour.

The precise dimensions of the bridge are unknown to us. It was apparently of 175 ft. span or more, and doubtless somewhat narrow. It had wooden top chords, cast iron posts and wrought iron lower members, like most of these old structures. Several of the cast iron posts will be seen broken off short in the cut.

The bridge appears to have been distrusted and shored up before the accident, but for how long or for precisely what motive we are not advised. All of these old Fink and Bollman bridges, as we said about a year ago in pretty frank terms, have really passed beyond their time of useful service; are carrying heavier loads than they were ever designed for; use cast iron with a freedom which is no longer tolerated, and ought to be taken down before they fall down, not only on the Baltimore & Ohio, but on various other of the older roads. But it is not inappropriate to add, what we have also many times before said on occasions of this kind, and doubtless shall have occasion to say many times yet, that had the bridge been protected by rerailing guards, it would have probably been standing yet, since a derailed car in the middle of a train is almost sure to be replaced on the rails by them; and even had the Jordan guard illustrated last week been in use, the knocking down of the bridge would probably have been avoided, although the car would not have been rerailed.

A Peculiar Leak in a Water-Works Main.

A peculiar leak in a cast-iron water main recently occurred at Greenville, Mich., and is described by E. H. NEFF in *The Technic* for 1890.

A 12-in. main was laid across Flat River, and through the lowlands at one side it passed mostly through quicksand. Eighteen lengths of pipe were lowered by means of jack screws, and as a precaution against the springing of the joints but little yarn was used and the bell was run full of lead and thoroughly calked.

The pipe had been under a pressure of from 40 to 160 lbs. for about two months when bubbles arising near one of the banks betrayed a slight leak. Owing to press of work and the smallness of the leak immediate steps were not taken for its repair until about two weeks, when the water in the stream began to boil up furiously with a noise that could be heard for some distance. Upon examination it was found that the original leak had been through a series of blow-holes in the interior of the bell, which on the exterior was apparently perfectly sound. On reaching the outer edge the lip of the bell deflected the water, so that a stream about one-eight of an inch in diameter struck the spigot about a half inch from the face of the bell, and this jet of water, with the sand at that point, had cut a hole in the top of the pipe about a half-inch in diameter, the pipe here being about a half-inch thick. In addition to the hole cut entirely through the pipe there was a groove about the hole some ¾ × 3½ ins. This piece was cut out and the break repaired by first inserting a cast-iron plug, and then bolting together and over the break a collar of flat iron ⅜ in. thick and 3 ins. wide, having a recess over the hole. The lead about the small hole in the bell was cut away, the collar pressed close to the face of the bell, and finally the space in the bell and in the recess over the break were filled with lead and thoroughly calked. The repairs proved effectual.

Electric Light Car, Pennsylvania Railroad.

[WITH INSET.]

In the accompanying inset sheet we illustrate a car for the novel purpose of providing ample illumination at short notice at any point where a temporary need therefor arises, either at a wreck or washout, or new piece of construction, or about yards or shops. It has been in very satisfactory use for about two years on the Pennsylvania R. R., and the drawings are so clear as to need little further comment or description. Racks for 10 arc lights are provided, and the power is ample for running that number, or even two or three more lamps.

The boiler, which is only shown in outline, is of the upright tubular type containing 160 1¼ in. tubes 2 ft. 3½ ins. at the center and slightly longer at the sides, the top flue sheet being dishing. The entire length of sheet, which includes the fire-box, is 6 ft. 9⅝ ins., and the outside diameter, 3 ft. 4 ins. The stack is 11¾ ins. interior diameter at the throat. The lamp tripods are 25 ft. high, of the simple form shown in the illustration, and are carried in racks on top of the car, as shown. The car is supplied with the list of miscellaneous supplies shown with the engravings, and is thus prepared to quickly furnish almost any desired amount of light.

The Dunn Safety Switch.

The accompanying cuts show a safety switch invented by Mr. LOUIS DUNN, roadmaster of the Minneapolis, Lyndale & Minnetonka R. R., and applied experimentally on that road, at a place where a side track runs off at a tangent from a curve on the main line (as shown in the illustrations). Another switch has been placed in the Minneapolis yard of the Chicago, Milwaukee & St. Paul Ry.

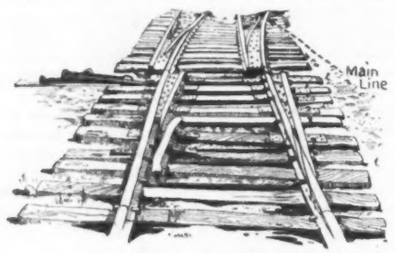


FIG. 1.—Switch Set to Main Line.

FIG. 2.—Switch Partially Open.

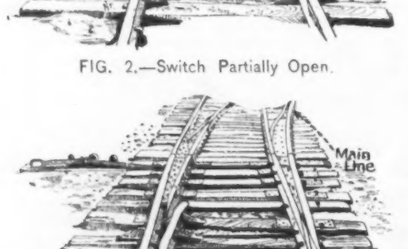


FIG. 3.—Switch Set to Side Track.

The cuts show the trial switch, which is built of scrap iron, and was only put in to protect the main line. In experiments it has been shown that a train will take the main line safely even when facing the switch and with the switch partially open. These experiments were made to show the safety to trains in the case of a switch accidentally or maliciously misplaced. The switch also has the advantage that a derailed car would be rerailed in passing it. The tie rods or bridle rods have two sets of lugs at each end to hold the flanges of both sets of rails. Bolts pass through the rails and filling, making a solid wrecking shoe. The throw of the switch is 6 ins.

In Fig. 1 the switch is shown set for the main line. Trains passing in either direction are carried on the treads of the wheels by and over the grooves in the rails, the extra rails or points being ¼ in. higher than the main track proper. In Fig. 2 the switch is partially open. A train running toward the frog (facing the switch) would pass onto wrecking shoes so arranged that the one on the right acts as a guard rail and guides the wheels on the other side through a groove and onto the main rail. A train running from the frog (trailing the switch) will pass onto wrecking shoes so arranged that the one on the right, as the train runs, acts as a guard, while the one on the left is so arranged that the wheels will pass through a groove to the main line. In Fig. 3 the switch is shown set for the side track. A main line train trailing through the switch will pass in safety on the extra rails provided for that purpose, descending through the groove onto the main line rail. By duplicating the combination, a junction or three-throw switch can be protected. With three of these switches at a **Y**, trains can run round in the ordinary direction without throwing a switch.

Electric Launches.

Electric launches as pleasure boats are discussed in *The Electrical Engineer* by FREDERICK RECKENZAUN. The author has constructed an electric launch, and describes the proper details as follows:

The hull need not materially differ from that of a steam or naptha launch, but wood is preferable to iron or steel in view of the possibility of acids leaking from the storage battery. An incidental advantage of the electric launch is that the battery may be so placed as to act as ballast, and the stability may thus be made to exceed that of any other type of launch if the propelling apparatus be properly placed.

The motor should have high efficiency, with special compactness, low speed and reasonably light weight. It should be placed as far back as possible, and the author says "a low armature speed (say 500 to 800 revolutions) will admit of coupling directly to the propeller." [This seems a pretty high speed for a propeller.—ED.] No automatic governing devices are required, and if different rates of speed are required they may be obtained by arranging the battery in sections and bringing these into service partially or wholly, as desired.

The battery may be as large as its bulk will permit. With ordinary launch hulls the average battery load that can be carried conveniently is about one-third the actual loaded displacement of the boat. Taking a battery of a common type, the author says that, per cubic foot, it will weigh about 175 lbs., and will have a capacity of 1,230 watt-hours, with a normal discharge rate of 210.1 watts per hour.

With the type of battery above assumed, if it is to be worked at "normal" rate, the capacity in electrical horse-power of the motor required will be equal to the number of cells multiplied by 0.0647, the working rate in electrical HP. per cell, or to the number of cubic feet of battery multiplied by 0.2816, the corresponding constant per cubic foot. For a rough preliminary calculation, on the basis that the weight of battery represents one-third of the total weight, we have,

$$\text{Capacity} = \frac{D}{3} \times 3.604 \text{ electrical HP.}$$

where D = total displacement (weight) in tons and 3.604 the working rate of battery in electrical HP. per ton (12.8 cu. ft.) The duration, T, of the run in hours for one charge of battery will be:

$$T = \frac{C}{R} \text{ hours, } C \text{ denoting capacity of battery in watt hours and } R \text{ denoting rate of delivery in watts.}$$

Since the power required to propel a vessel varies as the cube of the speed, and since the duration of the run varies inversely as the power (rate of delivery) it follows that the *mileage* covered by one charge of battery will vary inversely as the *square* of the *speed*. In practice, due allowance is to be made for the characteristics of the motor and for a falling off in the total output of the battery when pushed to a high rate of delivery.

The lack of charging facilities are a practical hindrance to the rapid introduction of electric launches. Where an electric lighting or power current is not available, of course a charging station is a necessity to the operation of an electric launch. The batteries may be charged in place or may be removed. If a fleet of boats is to be charged, suitable facilities for removal with duplicate sets of batteries will save delay of the boat for charging.

It is in operation that the chief advantages of the electric boat are manifest. The pilot can act at the same time as engineer, for he can stop, start or reverse as easily as he may give a signal, and need not wait for a response from the engine room. There is no danger of explosion, and no consumption of fuel or energy when the boat stops. Smoke, smell, soot, ashes, dirt, grease, heat, and noise, all of which are inseparable from the steam launch, are unknown here. The battery can furnish light as well as power when required.

As regards first cost, it must be admitted that a storage battery and electric motor cannot be made or purchased at the price of an ordinary steam or naphtha engine of the same power. The cost of charging facilities is the weak point. It about equals that of the launch itself. If the charging plant can be used for electric lighting as well, the cost is of course much reduced. But if a fleet of electric launches can be charged from one central station, the saving in running expenses may more than offset the enhanced first cost. One engineer at the stationary engine takes the place of an engineer on each boat. Again, in an electric boat the machinery occupies space which would be of little or no use to passengers, while in steam or naphtha boats a third to half the space, and the best part of the boat at that, is devoted to the boiler and engine. For a given number of passengers, therefore, the electric launch would be smaller, require less power, and so cost less to run.

The following is an estimate of the cost of equipping and operating 12 electric launches, each 28 ft. long, 6 ft. beam, carrying 1 ton of storage batteries, to run 60 miles at 6 miles per hour with one charge:

12 hulls complete	$6,600
12 tons storage batteries (capacity 16,240 watt hours per ton) at $560 per ton	6,720
12 motors, at $400	4,800
12 screw propellers and accessories	1,200
Switches, wires, incandescent lamps (4 per boat)	480
Acid and labor of placing electric outfit	1,200
Seat cushions, ropes, tools, etc.	300
Total, 12 boats complete	$21,300
Or $1,775 each.	
CHARGING STATIONS.	
Land and buildings (on suburban water front) say	$4,000
Steam plant, 60 HP., completed, erected	4,000
Dynamo, cap. 40,000 watts, erected, complete	2,000
Charging circuits and appliances, erected	250
Mooring facilities, tools, etc.	500
Total cost of station, say	$10,750
Grand total cost of 12 launches with charging facilities and real estate	32,050

ESTIMATED COST OF OPERATION.

It is assumed that each of the 12 launches makes a daily run of 60 miles, divided into six trips of 10 miles each (three round trips) during five months in the year:

12 pilots at $2.50 per day each, for 5 months	$4,500.00
1 station engineer, at $3 per day for 5 months	450.00
1 station fireman at $2 per day for 5 months	300.00
1 station laborer at $1.75 per day for 5 months	262.50
Coal (4 lbs. per HP. hour, 6 HP. for 7 hours daily), 11¼ tons (for 5 months) at $4 per ton	450.00
Oil, waste, miscellaneous supplies and incidentals for 5 months, say	200.00
Labor, etc., putting boats in running order at beginning, and storing same at end of season, say,	360.00
Depreciation per annum on boats and propelling apparatus, at 10% on $21,300	2,130.00
Depreciation of station machinery and appliances, at 6% per annum on $4,750	285 00
Interest per annum, at 6%, on capital of $32,050	1,923.00
Total operating expense, depreciation and interest	$10,860.50
or $905.04 per boat per annum.	
Total mileage run per boat per month (60 per day)	1,800 miles.
Total mileage run per boat in 5 months	9,000 "
Total mileage run, 12 boats, at 9,000 miles each	108,000 "

Cost of operation, including running expenses, depreciation and interest, as per above estimate, $= 10\frac{5}{100}$ cents per boat mile. The boats assumed can seat 20 passengers and over. If an average of only *one-half* of this number is constantly carried, paying fare at the rate of *one cent per mile* each, the receipts will equal the operating expense, depreciation and interest on investment, as above.

Results of Mine Legislation.

The *Colliery Engineer* has compiled an interesting table showing the number of deaths per year since 1870 from accidents in the anthracite coal mines of Pennsylvania. In 1870 the first Anthracite Mine Ventilation Act was passed, and since then a number of laws looking to the safety and comfort of the miners has been enacted. Inflammable structures other than the necessary pulley frames and trestles

cannot be built now within 200 ft. of the mouth of a shaft. All surface openings and dangerous entrances must be fenced off; telephones and speaking tubes extend over many parts of the mines; the cages now have rails, safety catches and overhead covers, while indicators show their position in the shafts. Steam boilers must now be located at least 100 ft. from the breakers. No person is now permitted to have charge of the inside workings of a colliery until he has passed an examination in the theory and practice of mining and been awarded a diploma. That such laws have resulted in halving the danger of mining can be seen from the following table:

Year	No. of men, in thousands.	No deaths.	Tonnage, in thousands.	Tons mined per death. Thousands.	Year.	No. of men, in thousands.	No deaths.	Tonnage, in thousands.	Tons mined per death. Thousands.
1870.	.....	211	12,654—	60—	1880	73+	202	24,843+	123—
1871	37+	210	13,868+	66+	1881.	76+	273	30,210+	111—
1 72	45—	166	13,900—	84—	1882.	82+	292	30,867+	106—
1873.	48+	224	18,751+	84—	883.	91+	323	33,701—	104+
1874.	53+	231	17,795—	77+	1884.	101+	332	32,561+	98+
1875.	70	238	20,895+	88—	1885.	101--	356	33,521—	94+
1876.	70+	228	19,611+	86+	1886.	103+	279	34,065—	122+
1877.	67—	194	22,678—	114—	1887.	107--	316	37,137+	118—
1878.	64—	187	18,662—	100—	1388.	117+	364	41,638+	114+
1879.	69—	262	27,7.1+	106—	1889.	119+	384	39,516—	102—

+ Designates an amount which is less than 500 tons too small; — designates an amount which is less than 500 tons too great.

In examining these figures we must bear in mind that the mines are now much deeper than in 1870, so that the difficulties of working are now greater and hence the real progress has been more than the table shows.

Comparing these figures with the corresponding figures for the British coal mines; from 1883 to 1887, their average loss of life was 1.88 in every 1,000 persons employed, about half our figure. From 1874 to 1883, the average loss per 1,000 persons was still below ours, or 2.24. Where our anthracite mines lose, at their best average record, a life for every 122,987 tons raised, the English mines raise 543,000 tons, or nearly five times the amount. Yet our seams are broader and our mines are not so deep. It is plain that our rules are by no means perfect as yet, but owners of mines are certainly on the side of more efficient regulations, knowing, as they do, the financial loss attending every disaster.

ANOTHER NEW ALUMINUM EXTRACTING PROCESS is reported from Atlanta. One MICHEL EMMI is the inventor this time, and associated with him in the usual enthusiastic manner are SAMUEL W. GOODE, J. S. HOPKINS, PHILIP HARALSON and others. The basis of the new process is not given, but 50 cents per lb. is said to be a liberal estimate of the cost of manufacture. Thus far, however, Mr. EMMI has purchased the manufactured aluminum for exhibition to his stockholders from the Pittsburg Reduction Co.

THE WATER POWER DAM AT TOPEKA, KAN., has been located at a point 3 miles above the city, and contracts for its construction and for the turbines, dynamos, etc., required are to be let at once by Anthony, Holmes & Co.

A SCHEME FOR ELECTRIC LIGHTING all the large towns of Saxony, by means of great cables connected with the coalpits of the Planensgrund, is on foot, and is said to be watched with deep interest in Berlin. The first scheme of this kind which is successful in any part of the world will doubtless be followed by many others.

THE LARGEST GAS ENGINES EVER BUILT are now nearing completion in the shops of Schleicher, Schumm & Co., Philadelphia, Pa. The plant is to consist of three engines, built from the same drawings, and each is to indicate at least 100 HP. They are guaranteed to develop a horse power with 1½ lbs. of coal in daily service.

AN INTERNATIONAL EXHIBITION OF MINING AND METALLURGY is now on in London, but is satirically stated to suggest rather an exhibition of the mineral products of New South Wales and South Australia, there being but little from any other country and practically nothing from England. The business of holding these exhibitions seems to be found profitable in London, and there is almost always one going on. The diamond industry of New South Wales is becoming an important one; some 50,000 have been found to date, the largest weighing over 16 gr., or 5 carats.

THE INCREASING CONSUMPTION OF RUBBER in the arts makes its permanent supply an important question, especially to those engaged in electrical work. Practically all the rubber product of the world comes from native forests and is collected by savage or half-civilized natives, whose crude methods rapidly destroy the trees. Great interest in the possible profits of rubber-tree culture is felt in tropical countries. The *Mexican Financier* recently published a series of articles on this subject, and every copy containing the articles was sold, besides a special edition. While the present product of Mexican rubber is small, it is believed that by the establishment of rubber-tree plantations large quantities might be produced. A company has recently been formed in London to purchase rubber-tree estates in all parts of the world, the first operations being in the African province of Liberia. The great obstacle to the cultivation of the rubber-tree is that about 15 years are required for the trees to come to maturity. Of the rubber-tree plantations which have been started in several parts of the world, therefore, few have, as yet, reached the bearing age. One successful plantation in Honduras, however, 20 acres in extent, yields a profit of $800 a year to its owner.

THE INSTITUTION OF CIVIL ENGINEERS has at last been formally declared to be an organization "for the promotion of art and science," and so exempted from income tax, after a long contest, which has extended over several years. The Inland Revenue Commissioners claimed payment of income tax, but the Institution resisted on the ground that it was exempted as being formed for the promotion of art and science. The Commissioners denied this, and maintained that the Institution mainly promoted the interests of a class. The Queen's Bench decided in favor of the Commissioners, but the Repeal Court reversed that decision, and "the House of Lords" (i. e., the "law Lords" therein) has now upheld that of the Court of Appeal. This of course settles the matter also for all institutions similar in their objects to that of Civil Engineers.

CEMENT WORKS with a daily capacity of 250 barrels are being constructed about four miles from Yankton, S. Dak. The cement is made from gypsum and clay, found near by in large quantities.

THE WORLD'S FAIR, it is now stated, will not have for its site the lake front, but will be located in Jackson Park instead. All is still in uncertainty, however, the conflict of interests being a sharp one, and the loss of time is becoming a very serious matter.

THE CHANNEL SPAN OF THE OHIO RIVER CONNECTING RAILWAY BRIDGE was swung into position by the Keystone Bridge Co. on Aug. 19. The span is 523 ft. long, 25 ft. wide, about 70 ft. high and weighs 915 tons. It was constructed on trestle work resting on piling, somewhat below the site of the bridge. False work 11 ft. high was constructed on each of nine barges, and these were towed beneath the span. Then water was pumped out of the barges until they rose high enough to lift the span and its false work so as to clear the piles upon which they had been resting. The barges were then towed into the stream, turned from a line parallel to one at right angles with the shore, then towed up-stream into position. By partially filling the barges with water the span was lowered into place. The operation was in every way successful, and a credit to the Keystone Bridge Co. The span is about 72 ft. high in the clear.

SENTIMENT IN FAVOR OF FILLING in the Harlem River instead of improving and bridging it has conspicuously developed in Congress, and seems to be on the increase elsewhere, as are the number of reasons advanced for such a course. We are disposed to believe that it would be better, on the whole, to fill it in altogether, and that this will eventually be done; but powerful landed interests will oppose it.

A LAKE WASHINGTON SHIP CANAL is being pushed by Seattle people, and the pending River and Harbor bill contains an appropriation of $10,000 for surveys of the route. J. H. MURPHY, of Davenport, Ia., is interested in the project.

COPPER MAY BE ANNEALED without danger of overheating or loss of temper by surrounding it with an atmosphere of steam, says G. W. CUMMINS in the *Scientific American*. At present it is necessary to use only the highest grades of refined copper for drawing or rolling, because this grade does not deteriorate by overheating as do the less expensive grades. By the use of steam, an ordinary annealer, such as is used for iron, can be used, and the article to be annealed remains perfectly bright. By this method also, the author thinks it possible to produce bright copper rods or plates direct from the rolls.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO—Existing Roads.

Sebasticook & Moosehead.—Subscriptions are being raised by the people along the route to secure the extension of this Maine road from Hartland to Athens.

Rockaway Valley.—Work will commence soon on the extension from Peapack to Mendham, N. J., surveys for which have been in progress for some time. It is intended to extend the road to Morristown during the next year. The road is being built entirely by subscriptions and other local aid from the people along the route. J. V Melick, of White House, N. J., is Chief Engineer.

Cincinnati, Wabash & Michigan.—The grading on the line from Anderson to Rushville, Ind., is nearing completion, and tracklaying is rapidly progressing from both ends. It is expected that the line will be completed by Sept. 13.

Ottawa & Gatineau Valley.—The grading is nearly completed on the first 20 miles of this Canadian road, and work will commence at once on the second section. The road is projected to run from Ottawa to Karyabaryua P. Q., 50 miles. W. D. Harris, of 14 Metcalf St., Ottawa, Ont., is Chief Engineer.

Toledo, Columbus & Cincinnati.—The grading has been completed on the line from Kenton to Columbus, O. 50 miles, and tracklaying is now in progress. J. C. Williams, of Kenton, O., is Chief Engineer.

New Albany Belt & Terminal.—Work is being rapidly pushed ahead on this Indiana road. Mr. E. Crumbo who has the contract for the masonry, has a large force at work along the wharf between West First and East Third streets, and the grading is progressing favorably under the contractor, Mr. Conger.

Baltimore & Ohio.—The surveys have been completed and it is now stated that the line from Butler to Punxsutawney, Pa., will be built soon. From Butler to Pittsburg the Pittsburg & Western R. R. tracks will be used, and at Punxutawney connection will be made with the Buffalo, Rochester & Pittsburg R. R. and an outlet secured to the East.

Lake Temiscamingue Colonization.—Stockholders of the Canadian Pacific Ry. are stated to have secured control of this road, and will, it is stated, complete it at once.

Toledo & South Haven.—A project is on foot to extend this Michigan road from Lawton, Mich., to Toledo, O., and to change it to standord gauge.

Pittsburg, Shenango & Lake Erie.—Thos. H. Wells, a stockholder of this railway, states that work will commence at once on the long-talked-of extension of the road from Greenville, Pa., to Conneaut, O. It is expected to have the line completed by Jan. 1, 1891.

Wheeling & Lake Erie.—Construction has been commenced on the extension from Portland to Bellaire, O. It is expected to have the grading completed to Martins' Ferry by October 1, and tracklaying will follow as closely as possible.

Baltimore & Eastern Shore.—Tracklaying is now in progress between Salisbury, Md., and the Nanticoke River, and several miles have already been laid. As soon as this section is completed, and the bridge across the Nanticoke River is finished, the road will be opened for traffic from Bay Side to Salisbury.

Findlay, Fort Wayne & Western.—This company, merging the Findlay & Western and Fort Wayne & Findlay railway companies, has been incorporated. The companies merged in the Findlay, Fort Wayne & Western were incorporated in Ohio and Indiana respectively, and contemplate the operation of a road between Findlay, O., and Fort Wayne, Ind. The consolidated company owns the American Midland R. R., recently sold at foreclosure, 24 miles in length, extending from Findlay to Ottawa, O. Contracts are now being let for the construction of the proposed road from Ottawa to Fort Wayne, and work is to begin this fall.

Chicago & Atlantic.—This railway has been purchased at foreclosure for $5,000,000 by the reorganization committee of the first and second mortgage bondholders. The company will be reorganized in the interest of the New York, Lake Erie & Western R. R. Co.

Cleveland, Cincinnati, Chicago & St. Louis.—At a recent meeting of the officials of this road and a citizens' committee, the organization of the Brookville, Richmond & Union City Ry. Co. was effected. The road is projected to run from Brookville, Ind., via Liberty and Union City, to a connection with the Peoria & Eastern Branch a distance of about 20 miles. It is stated that this line will be built instead of the proposed extension of the White Water R. R. from Beson's Station to Richmond. The officers of the company are: President, Joseph Ramsey; Vice-President, J. M. Garr; Secretary, Isham Sedgwick, and Treasurer, B. M. Sutton. The surveys will begin at once.

Temiscouata.—About two-thirds of the grading has been completed on the first 10 miles of the extension from St. Edmondston to the mouth of the St. Francis River, along the John River. The entire line is 30 miles long, of which 20 miles have been located. Tracklaying will begin in September and it is expected to have 20 miles completed this year. The 200 ft. steel bridge across the Madawaska River is completed.

Baltimore Belt.—A large number of bids have been received for building this road. The contract will be awarded as soon as the bids can be examined, but active work will not commence until after the meeting of the Baltimore & Ohio directors to ratify the traffic agreement recently entered into, which will take place Sept. 8. The road will be 7 miles long, double-tracked and will cost $6,000,000.

Projects and Surveys.

Penobscot & Shore Line.—A railway company by this name has been organized at Portland, Me. Among the directors are Payson Tucker and H. B. Cleaves, of Portland.

Labrador.—A press dispatch says:

A large party of English capitalists and engineers are expected to arrive in New York soon They will go immediately to Canada and will charter a steamer to visit Labrador and the Straits of Belle Isle, with a view to surveying the north shore and rsporting on the feasibility of Bender's Labrador railway scheme.

River.—Chartered in Indiana to build a railway from Jeffersonville to New Albany, Ind. Among the directors are Col. E. A. Maginness and Benj. L. White.

Moose River.—A railway to run from Boonville, N. Y., up the valley of the Moose River to the lakes of the Fulton chain, is talked of.

Morristown & New York.—A project is on foot to build a railway from Morristown, N. J., via Whippung, Caldwell and Montclair, to New York.

SOUTHERN—Existing Roads.

Bristol, Elizabethton & North Carolina.—Durand & Co. have the contract for 40 miles of this road, and will sublet the work at once. Geo S. Bruce, of Bristol, Tenn., is Chief Engineer.

Seaboard Air Line.—Work is making rapid progress on the Georgia, Carolina & Northern R. R., and it is expected to have the road in operation from Chester to Clinton, S. C., by Sept. 1. Grading is also being rapidly pushed on the Georgia division.

Charleston, Sumter & Northern.—This company has completed its six-mile branch from Eutauville to Ferguson, S. C., and opened it for traffic.

Georgia Southern & Florida.—Construction is reported commenced on the line from Tifton to Thomasville Ga., 52.8 miles.

Cincinnati Southern.—Construction has been commenced on the short branch to connect the road with the Cumberland River at Burnside, Ky.

Rutledge & Julien.—The rails have been delivered, and trucklaying will soon begin on this short Alabama road.

Norfolk & Western.—This company will build a short branch from Lynchburg, Va., to machine works near that place.

Norfolk & Western.—A correspondent writes as follows:

Train service on the Clinch Valley Division of this road has been extended from Honaker to St. Paul, Wise Co., Va., the latter station being 80.2 miles from Bluefield, W. Va., on the New River Division. The prominent stations are: Graham, 3.2 miles; Tip Top, 13.1 miles; Tazewell, 22.4 miles; Pounding Mill, 34.1 miles; Cedar Bluff, 37.8 miles; Richlands, 41.1 miles; Swords Creek, 52.2 miles; Honaker, 57.1 miles; Cleveland, 68.5 miles; Castlewood, 77.3 miles; and St. Paul, 80.2 miles. The track is laid 1½ miles west of St. Paul, and is being rapidly extended toward the terminus of the road, Norton (103 miles from Bluefield), the junction with the Louisville & Nashville R. R., which latter is well under way between Cumberland Gap and Norton. The Big Creek branch, which leaves the Clinch Valley division at Richlands, and extends 4 miles northward to extensive coal fields, has also been completed by the contractors Sexton & Houston, who are now engaged in building another branch line up Coal Creek for this same company. This latter branch opens extensive gas coal deposits near Doran.

Marietta & North Georgia.—This road is nearly ready for operation. Work is being pushed on the Knoxville Southern R.R., or Tennessee division of the road, and the entire line is practically finished. It is stated that the branch from Marietta to Atlanta will be built soon.

Roanoke & Southern.—Andrew Onderdonk, Winston, N. C., Chief Engineer, writes as follows:

Tracklaying is now completed and the road in operation from Winston to Madison, N. C., 42 miles, and the grading from Madison to Martinsville, Va., 28 miles, will be completed in a short time and the road opened for traffic by Dec. 1. A 25-mile section from Martinsville north has recently been put under contract. The contractors are: Breen & Feely, 3 miles; Allen, Mosely, Davis & Co., 11 miles, and McCabe Bros. & Co., 11 miles. The remainder of the line to Roanoke, Va., is now being located.

Nashville, Chattanooga & St. Louis.—Hunter McDonald, Huntsville, Ala., writes as follows:

About 150 men and 150 teams are now at work regrading the Tennessee & Coosa extension from Littleton to Guntersville, Ala., 25 miles. This road was nearly all graded between 1849 and 1860, and the present work consists in regrading the old roadbed. There are 5.3 miles of 1.6 % grade and 4 miles of 2 % grade. There will be a bridge over the Tennessee River and several trestles. The principal business of the road will be lumber, coal and iron ore. Allison, Shafer & Co., of Chattanooga, Tenn., have the contract. It is expected that tracklaying will begin about Sept. 1, and the road opened for traffic by May 1, 1891.

Baltimore & Ohio.—Engineers are surveying a line from Weston to Clarksburg, W. Va., with a view of ascertaining the probable cost of building a new line between those two places. The grades of the present line are very heavy.

Projects and Surveys.

Tombigbee.—This company organized some years ago, has, it is stated, let the contract for its line from Columbus, Miss., to Decatur, Ala., and work is to be commenced at once.

Dunlap Coal, Iron & Railway Co.—Chartered in Tennessee to build a railway from Dunlap to Chattanooga, Tenn., 28 miles. Jas. H. Hoffacker, of Wilmington, Del., is President.

NORTHWEST.—Existing Roads.

Burlington & Missouri River.—The extension of this road in Wyoming has been completed from Newcastle to Iron City, 28 miles. Grading contracts for additional 100 miles have been let.

Chicago, Fort Madison & Des Moines.—The city of Ottumwa, Ia., has voted $35,000 in aid of this railway.

Ottumwa & Kirkville.—This company operating a road from Ottumwa to Kirkville, Ia., 11.66 miles, will, it is stated, discontinue business and tear up its track.

Chicago, St. Paul, Minneapolis & Omaha.—The Randolph & Northeastern Nebraska Ry. Co., has been organized in the interest of this company to build the extension from Randolph, Neb., northwest.

Kearney & Black Hills.—Geo. Cox., of Kearney, Neb., Chief Engineer, writes as follows:

This road is projected to run from Riverdale, Neb., via Amherst, Watertown, Miller, Eddyville and Oconto, to Callaway, Neb., a distance of 65 miles. Tracklaying commenced June 15 and up to July 31, track had been laid to Miller, 26 miles. It is expected to have the entire line completed by Sept. 15. The work is generally light; maximum curve 3° and maximum grade 26.4 ft. per mile. The route is through an agricultural country. All of the right of way has been obtained, and about $100,000 local aid secured. E. C. Davidson is President.

Projects and Surveys.

Eau Claire, Mississippi River & Lake Superior.—Chas. E. Bussell, 516 Bridge St., Eau Claire, Minn., writes as follows:

This road is projected to run from Ashland, Wis., via Chippewa Falls, Eau Claire, Eleva and Independence, to Winona, Minn., 200 miles. The surveys have been completed from Chippewa Falls to Independence, 60 miles. From Chippewa Falls north the route is through a heavy timber section, and from Chippewa Falls south the line passes through a rough, open country. The maximum grade is 1%, and the maximum curve 3°. There will be two bridges 600 ft. long, and two tunnels 800 ft. and 950 ft. respectively. The principal business will be in ore from the Lake Superior district, and lumber from the pine region of northern Wisconsin. R. F. Wilson is President.

Pierre, Aberdeen & Black Hills.—Arrangements are reported completed for the construction of this road from Aberdeen to Pierre, S. Dak.

Wisconsin, Bee Line & West Superior.—Chartered in Wisconsin to build a railway from Milwaukee to West Superior, Wis.; among the incorporators are: F. M. Fox, H. W. Newton and J. L. Smith.

Sioux City & Northwestern.—At a recent meeting the following officers were elected: President, T. P. Gere; Vice-President, J. F. Duncombe; Treasurer, A. S. Garretson; Secretary, E. M. Frazee, and Chief Engineer, L. T. Wakefield.

Chicago Elevator Terminal.—This company has been incorporated in Illinois, to construct a railway on the south side of Chicago, extending from Twelfth street to Little Calumet River and Blue Island, with branches. The capital stock is $25,000,000, and the incorporators and first Board of Directors are: Joseph T. Torrence, Joseph Donnersberger, Thomas W. Johnson, James J. Reynolds and Charles Eldred, all of Chicago.

Ahnapee & Western.—Chartered in Wisconsin to build a line of railway from a point on the survey of the Kewaunee, Green Bay & Western R. R. to Ahnapee, a distance of 14 miles. Among the incorporators are M. C. Haney, Ahnapee, and S. W. Champion, of Green Bay Wis.

SOUTHWEST.—Existing Roads.

Fort Worth & Rio Grande.—L. B. Russell, of Comanche, Tex., writes as follows:

This road is projected to run from Ft Worth, Tex., to Topolobampo, Mex., on the Pacific coast. The road is now completed from Fort Worth to Dublin, Tex., and construction is in progress on an extension from Dublin to Comanche, Tex., 22 miles. The grading is about completed on this section, and tracklaying is now in progress, several miles being already laid. Martin, Byrne & Johnston, of Colorado, Tex., are the contractors. The route is through a moderately hilly and undulating country. There will be one bridge of considerable size across the Brazos River. All of the right of way has been secured, and about $40,000 in local aid, including grading and depot grounds secured. The road will be a feeder to Ft. Worth, and its principal business will be in cattle, cotton and grain.

Corpus Christi & South American.—Work at the Brownsville end is making good progress, and the line is being located preparatory to commencing work at Corpus Christi. D J. Thayer, of Corpus Christi, is Chief Engineer.

St. Joseph, Iron Mt. & Southern.—An extension of the Bald Knob branch, from Bald Knob to Carthage, Mo., is contemplated.

Kansas City Suburban Belt.—The grade crossing suit between this company and the Missouri Pacific and the Chicago & Alton Ry. Cos. has been decided in favor of the belt line. Work will now be rapidly pushed and the line opened for traffic soon.

Projects and Surveys.

Arkansas & Gulf.—Locating surveys will begin on this road in September. About 8,000 tons of steel rails have been purchased. W. R. Burgholz, 15 Cortlandt St., New York city, is President.

Camden & Alexandria.—The contracts are reported let for constructing a portion of this Arkansas road. C. C. Henderson, Camden, Ark., is President.

ROCKY MT. AND PACIFIC.—Existing Roads.

Northern Pacific.—Chief Engineer Kendrick states that this company has 300 miles of railway projected for early construction. This consists of the Tacoma, Olympia & Gray's Harbor branch, which will run from Lakeview, one of the suburbs of Tacoma, southwest along the shore of American Lake, to Olympia, thence to the junction of Black River with the Chehalis, a distance of 46 miles. Connection is made at this point with a branch now under construction from Centralia and continues down the Chehalis River to Acost, a point on South Bay, the south shore of Gray's Harbor. This is 65 miles from Centralia. About one-half the grading has been done between Lakeview and Olympia. West from Centralia 10 miles of grading have been completed and 5 miles of track laid. The Yakima & Pacific Coast Line will leave the present line at Chehalis and run up the valley of the Chehalis and then down the Willapa to South Bend at its mouth on Willapa Harbor, the northern portion of what is known as Shoalwater Bay. This line will be 54 miles long. The contract for the construction of both these lines has been let to Griggs & Heustis of Tacoma. The several branch lines mentioned run in a southeasterly direction from Tacoma.

Running northwest there are several lines of importance. These are the Green River & Northern, running from Palmer, on the Cascade division, north to Durham. This line when completed will be 18 miles long. The Northern Pacific & Puget Sound Shore is building from Black River Junction northward along the east shore of Lake Washington to a connection with the Seattle, Lake Shore & Eastern near Bothwell, a distance of 21 miles. In addition to this construction on the coast proper, the company is building a little over 100 miles of road east of the Cascades. Contractors Donald Smith & Howell, of Spokane Falls are now building the Spokane & Palouse extension, which runs via Pullman, Bear Creek and the Potlatch to Lewiston, thence up the Snake River and Tammany Gulch, a distance of 76 miles. The Central Washington line is being extended from Elmira to Grand Coulee, a distance of 27 miles. Engineers are in the field continuing this line west of the Grand Coulee to the Columbia River into the Okanogan mining region. In addition to this 308 miles of road under way, the company is building large shops at Tacoma.

Port Townsend Southern.—A large force of men is to be put at work on this road, and construction is to be pushed as rapidly as possible. From the southern terminus south of Port Townsend south to Hood's Canal, the road will soon be completed, and from Olympia north to Union City good progress is being made. If this line is completed by Nov. 1, it will be put in operation in connection with a ferry line along the canal until the line along the canal bank is completed.

Seattle, Lake Shore & Eastern.—A press dispatch says:

Forces are being concentrated on the Seattle, Lake Shore & Eastern Railway grade, which is completed for 16 miles south from the international boundary, and of the 10 miles between North Fork and Samish summit only about 3 miles remain to be graded. The San Francisco Bridge Co. has begun work on the bridge at North Fork, at which place a revetment wall is also being constructed. A force is also now employed in the rock cut. The end of the track is now 4 miles north of Wooley Junction, at which point enough rails are in waiting to complete the line to North Fork, and the balance to reach the boundary will be on hand in the meantime. The bridge across the Stillaguamish River is finished and the track laid for 2 miles beyond. At a point about 4 miles north of the town, work is progressing rapidly on an extensive trestle. This is to be completed in 10 days, and in about 6 weeks the track may be pushed to completion.

Seattle & Northern.—Tracklaying has been completed from Anacortes to within 7 miles of Hamilton, Wash., and it is expected that the entire line will be completed this month.

Denver & Rio Grande.—About 250 men are at work on the Rifle Creek extension, and it is intended to have the

line completed in a month. Tracklaying has been commenced on the Alamosa & Villa Grove branch.

Great Northern.—The contract for laying the track on the Fairhaven & Southern R. R., from Fairhaven to a connection with the New Westminister & Southern R. R., has been let to McCoy & O'Brien, to be completed Oct. 15. The contracts for building the roadbed of the Seattle & Montana R. R., from Seattle to Fairhaven, have been sublet and work is in progress. Shepard, Henry & Co., who have the general contract for tracklaying and bridging, will probably sublet the work. Contracts willl soon be let for constructing bridges across the Snohomish, Stillaguamish and Skagit rivers.

Southern Pacific.—This company has agreed to construct the line from Ellwood to Santa Margarita, Cal., on condition that right of way and depot facilities be granted. It is thought that this will be done. The work will be very heavy in some places and several tunnels will be necessary.

Union Pacific.—About 400 men and a large number of teams are at work on the Portland and Puget Sound R. R. The principal work is being done between Tacoma and Olympia, and between Portland, Ore., and Kalama, Wash., but it is expected to have the entire line under active construction soon. About 90 % of the grading has been completed on the line from Milford, Utah, to Mendon Valley, Nev. The line is 128 miles long, including a branch to Pioche, Nev.

Spokane Falls & Northern.—Only about 15 miles of this road remains to be completed. The terminus of the line for the present will be near Little Dalles, Wash., where connection will be made with a steamer line on the Columbia River to Ravelstoke, B. C.

Projects and Surveys.

Georgetown, Silver Creek & Chicago Lakes.—Work is reported commenced on this Colorado road. The road is to run from Georgetown to Chicago Lakes, in Clear Creek Co. The object of the line is to furnish an outlet to the mines in that vicinity. Geo. W. Hall, of Georgetown, is President.

Frankfort, Pacific & Eastern.—Chartered in Oregon to build a line of railway.

San de Fuca & Northwestern.—A railway company by this name is to be incorporated in Washington. Among the projectors are: J. J. Malone, H. K. Moore, G. W. Peck and others. The road is to run from San de Fuca to Sedro, Wash.

Gig Harbor & Northwestern.—A project is on foot to build a railway from Gig Harbor, Wash., through the Olympic mountains to Port Angiles, Wash. The preliminary surveys have been completed. Frank C. Ross, of Tacoma, Wash., is at the head of the enterprise.

Western Montana & Idaho.—Engineers, supposed to be in the interest of this company, are surveying a line through the Bitter Root mountains. The road is projected to run from Missoula, Mont., through the mountains to Idaho.

FOREIGN.

Mexican Transcontinental.—The contract has been let to build this road from Matamoras de Tamaulipas, on the Rio Grande River, to Blazon, on the Pacific coast. The section from Matamoras to Galihinda only will be built at present.

Laguna.—W. F. Robertson, of Eagle Pass, Tex., has the contract to build this road from Biasca to San Pedro, Mex. Work will begin at once.

CITY TRANSIT.

Dummy Railways.—*Opelika, Ala.*—Capt. Dean will build a line.

Knoxville, Tenn.—S. McKinney, S. B. Crawford and F. S. Webb will build a line here.

Walla Walla, Wash.—The line to Milton, 12 miles distant has been located, and the right of way obtained.

Cable Railways.—*Portland, Ore.*—The Portland Cable Railroad Company has increased its capital from $300,000 to $500,000, in order to extend its line to Fairmount, a distance of 1½ miles.

Elevated Railways.—*New York City.*—On the return of J. J. R. Croes, Chief Engineer of the Suburban Rapid Transit Company, from a tour through Europe and Northern Africa, he was directed to place contracts for an additional mile of elevated railway on 3d Ave. Allston Gerry & Co. will put in the foundations and the Wallis Iron Works, of Jersey City, have the contract for the plate girder superstructure.

Chicago, Ill.—The Chicago Elevated Terminal Railway Co. has been incorporated with $25,000,000 capital by J. T. Torrence, J. Donnersberger, T. W. Johnson, J. J. Reynolds, and Charles Eldred. The promoters of the enterprise are virtually the same parties who built the Chicago and Calumet Terminal Belt Road and the financial suppport comes from Kidder, Peabody & Co.

Electric Railways.—*Portsmouth, N. H.*—An electric line is proposed.

Jamaica, N. Y.—The electric railway will soon double track its lines.

Glens Falls, N. Y.—The street railway has been granted permission to use electricity.

West Chester, Pa.—The Electric Railway Co. may extend its lines to Lenape Station.

Charlotte, N. C.—The Charlotte Consolidated Construction Co. has bought up all the street railways in this place. The Company will extend the lines and adopt electricity as a motive power.

Savannah, Ga.—The Real Estate Loan & Building Co. will build a line. J. S. Collins can give information.

Nashville, Tenn.—The Nashville Electric Railway & Power Co. will build a line as soon as the right of way has been obtained.

Knoxville, Tenn.—W. Morrow, of Nashville, J. McCammon S. Howell will build a line to Lake Ottosee.

Indianapolis, Ind.—The Consolidated Electric Storage Co., of Philadelphia, has the contract for supplying several Julien storage battery cars and a special charging dynamo to the Irvington line.

Chicago, Ill.—The Chicago & Lake Shore Electric Ry., which was recently incorporated, will build a double track line from Chicago, along the north shore through Fort Sheridan to Waukegan. The first section of the road will extend to Fort Sheridan, a distance of 25 miles, and will probably cost $1,500,000.

Detroit, Mich.—W. D. Robinson has petitioned for a franchise to build and maintain a city railway driven by any motive power save steam. The route proposed passes through a number of streets.

Galveston, Tex.—The Galveston Rapid Transit Belt Line has applied for a charter. The incorporators propose building a 5 or 6 mile line at an estimated expense of $100,000.

New Companies.—South Lake & Germantown Ry. Co. Savannah, Ga.; W. Royers, Pres't., W. Schweter, Sec'y. Banner City Street Ry. Co., Greenwood, Miss.; incorporators, H. E. Miller, J. S. McDonald, R. A. Bacon. South Heights Rapid Transit Co., San Antonio, Tex. Dallas, Tex., Cable Ry. Co.; capital, $600,000; incorporators-A. W. Childress, J. M. Wany, T. Field, C. W. Guild. Metropolitan R. R. Co., Dollas, Tex.; incorporators, M. Lasker, J. Runge, L. M. Openheimer.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Mason, Me.*—J. H. Bean, W. Bethel, Me., asks price of bridge 38 ft. long and 12 ft. wide, delivered.

Phillips, Me.—The Pittsburg Bridge Co. has the contract for a 150-ft. span iron bridge to replace a wooden structure recently destroyed.

New York, New Haven & Hartford R. R. Co.—This company will build a 335-ft. iron bridge across the Niantic River, near New London, Conn. It will have 4 spans of 50 ft. each, and a draw span of 135 ft. The cost will be about $200,000.

Clifton Forge, Va.—Bids are wanted for a bridge across Smith Creek, to be completed in 30 days. Address Clifton Forge Co.

Harpers Ferry, W. Va.—The Harpers Ferry & London Bridge Co., has been organized to build a steel bridge at this place.

Bristol, Tenn.—The city will issue $50,000 of bonds to construct 5 bridges.

Memphis, Tenn.—The piers for the bridge across the Mississippi River at Memphis are nearing completion. The iron work is now arriving and work on the superstructure will soon begin. The two west portal cylinders at West Memphis have been sunk to a depth of 80 ft., and are ready for the concrete filling.

Carrollton, Ky.—Congressman Dickerson has introduced a bill into Congress authorizing the Louisville, Covington & Cincinnati and other railway companies to construct a bridge over Kentucky River at or near Carrollton.

Newport, Ky.—C. L. Jungerman, City Engineer, will receive bids for constructing the iron or steel highway bridge over Taylor's Creek.

Lyons, Ia.—The Lyons & Fulton Bridge Company will build a highway bridge over the Mississippi River between Lyons, Iowa, and Fulton, Ill. The structure will be 2,650 ft. long from end to end of approaches, the river being crossed by one 200 ft. span, three 330 ft. spans, and one 360 ft. channel span, all on masonry piers, the superstructure to be of steel. C. F. Loweth, of St. Paul, Minn., is the Consulting Engineer for the Bridge Company. Contract has been let to the Chicago Bridge & Iron Works, for the entire work.

Sioux City, Ia.—The Phœnix Bridge Co., of Buffalo, N. Y., has begun work on the bridge across the Missouri River for the Sioux City & Ogden Ry. It will be a low bridge, with two draws. A large amount of material has already arrived.

Dardanelle, Ark.—The Dardanelle & Russellville R. R. will build a pontoon bridge across the Arkansas River at this place. The Kansas City Pontoon Bridge Co. has the contract.

Bastrop, Co., Tex.—The Commissioners' Court of Bastrop County will receive sealed bids for the construction of an Iron Bridge across Wilbarger creek at the Osborne crossing, about 7 miles from Elgin, in Bastrop county, until Sept. 1.

Houston, Tex.—Bids are to be asked for a 757 ft. bridge at Sabine street. The structure is to cost $5,783, of which $2,200 will be expended for the 100 ft. iron span.

Jefferson, Tex.—A bridge is contemplated over Jim's Bayou. Address County Commissioners, Marion Co., Tex.

Tyler, Tex.—A bridge over the Neches River is talked of.

WATER-WORKS.

NEW ENGLAND.

Waltham, Mass.—Improvements have been started at and about the Ludlow reservoir.

Providence, R. I.—It is probable that the Fruit Hill reservoir repairs will be made by the day, instead of by contract.

Meriden, Conn.—There is fear of a water famine, and immediate steps toward an additional supply are strongly urged.

MIDDLE.

Brooklyn, N. Y.—The City Council has authorized the purchase and laying of a 48-in. main with 36 and 30-in. branches from Ridgewood reservoir into and through the city; also the purchase and erection of a stand-pipe at Prospect Park reservoir; $700,000 was appropriated for the mains and $65,000 for the stand-pipe.

Perth Amboy, N. J.—A citizens' movement is on foot for the construction of water works, and J. C. Rossi has submitted to the Taxpayers' Association a plan for bringing from Mill Brook, 8 miles distant, a daily supply of 2,000,000 galls., at an estimated cost of $190,000. This town of some 6,500 people has been supplied since 1882 by a private company, but the city's contract with the company expires in about a year.

Allegheny, Pa.—Attention is called to the contracts to be let here, Oct. 1, as described in our advertising pages. Bids are asked on pumping engines, boilers, reservoir, filtering plant, pipe and gates.

Scottdale, Pa.—Work was begun, Aug. 13, on the reservoir and the distribution system of the Citizens' Water Co.

Baltimore, Md.—A petition for a better water supply in the vicinity of Eutaw and Lombard Sts. has been presented to the Water Board.

SOUTHERN.

Vinton, Va.—S. B. Mosby & Co., Bedford City, are said to have the contract for the Vinton Water Co.'s works.

Hinton, W. Va.—The Hinton Water-Works Co., it is reported, have let the contract for works to the Glamorgan Co., Lynchburg, Va., for $20,000.

Morganton, N. C.—The works will be built by the Morganton Water Supply & Transfer Co., and will consist of a 2,000,000-gall., daily, gravity plant.

Gaffney City, S. C.—Address F. G. Stacey.

Greenville, Ala.—Pipe is being laid by the company under the direction of Jas. H. Dow.

Alexandria, La.—The following is from A. P. Williams:

The Alexandria Water & Sewerage Co. propose to bring water from Castor Creek, 8 miles distant. A stand-pipe and both gravity and pumping will be used. The probable cost is $125,000, and capital has been promised. Population, 3,000.

South Pittsburg, Tenn.—It is reported that $40,000 will be expended in improvements.

Trenton, Tenn.—Specifications are being prepared for works. M. Oppenheimer is Mayor.

Newport, Ky.—Chas. L. Jungerman, City Engineer, states that bids will be received till Sept. 8 for the reconstruction and repair of the water-works reservoirs. The reservoirs have a capacity of 40,000,000 galls., and an area of 14 acres. Further details are given in the *Manual of American Water Works* for 1889-90.

NORTH CENTRAL.

Michigan City, Ind.—F. Wheeler has sent the following:

The Dowagiac (Mich.) Construction Co. has secured the contract for supplying the city with water. Work will be commenced immediately. Jno. Becks is Chairman of the Water Committee.

Chicago, Ill.—That part of the city formerly the Town of Lake is said to be almost without water. The lack of water is attributed to the large amounts drawn from the mains by means of pumps at the stock yard packing houses.

Springfield, Ill.—Some 440 ft. in length of the new infiltration gallery has been completed. The original plan was for a gallery 1,000 ft. long, but so large a volume of water enters the section already constructed that it may be deemed unnecessary to build the full 1,000 ft.

NORTHWESTERN.

Potwin, Kan.—The Council has granted a franchise to the Potwin Water Co., of Topeka. The company has a capital stock of $50,000. Henry Bennett and S. T. Howe are among the directors.

Creighton, Neb.—A recent fire has led to several meetings to discuss water-works.

Blue Hill, Neb.—A. A. Richardson, Consulting Engineer, informs us that bids for works will be opened Sept. 11, 1890.

Fargo, N. Dak.—The town thinks of buying the works.

SOUTHWESTERN.

Arkadelphia, Ark.—Address the Mayor in regard to proposed water-works.

Austin, Tex.—The city is asking for bids for $1,400,000 of bonds, the proceeds of which will be used to construct water and light works. The place has been supplied by a private company since 1875, and the present company, the Austin Water, Light & Power Co., has asked for an injunction to prevent the issuing of bonds by the city.

Beeville, Tex.—Address Mayor A. C. Jones for information regarding proposed works.

Cisco, Tex.—An election will be held at which the question of issuing water-works bonds will be voted upon.

PACIFIC.

Blaine, Wash.—The Chown-Weistling Co., it is said, will begin on Aug. 9 the construction of water-works.

Ellensburg, Wash.—On Aug. 14 the city sold $150,000 bonds at par to S. A. Kean & Co., New York. New water-works, sewers and other improvements will be constructed. Works were built here in 1888 by the Capital Hill Water Co.

Spokane Falls, Wash.—There is talk of the city putting in a new or additional plant costing from $150,000 to $200,000. E. H. Bartlett and A. Treat are on the fire and water committee.

Tacoma, Wash.—A special election will soon be held to determine whether the city shall build works, or continue to take water from the company. The latter's service is said to be inadequate.

Manti, Utah—Small gravity works have been proposed. The supply will probably be from springs in Funk's Cañon, about three miles distant. Estimated cost, $5,000. David James, of Salt Lake City, is interested, but the works will probably be owned by the town.

ARTESIAN WELLS.

Brule County, S. Dak.—The County Judge has received petitions from 15 townships for permission to bore for artesian wells in accordance with law passed by the last Legislature.

Alamosa, Col.—A flowing well has been secured at a depth of 612 ft.

Asbury Park, N. J.—The sum of $1,500 has been appropriated for another well.

IRRIGATION.

Finney County, Kan.—The Amazon irrigating ditch now under construction, will reach into the county. It takes water from the Arkansas River several miles west of Garden City, and will have a total length of 80 miles. It is expected that the ditch will be finished by spring, and that its total cost will be $500,000.

Culbertson, Neb. A water power ditch some 40 miles long will be built to this point between now and June 1, 1891. Buffalo Jones, Garden City, Kan., will probably have the contract.

Laramie County, Wyo.—The Wyoming & Nebraska Irrigation Co. has been incorporated, with a capital stock of $800,000. Water will be taken from the North Platte river for use in this county and in Scott's Bluff Co., Neb. The principal office will be at Denver.

Escondido, Cal.—The following is from E. F. Tabor:

The Escondido Irrigation District has voted to issue bonds to the amount of $150,000. A system of storage reservoirs, distributing pipes and flumes will be put in to irrigate about 10,000 acres of land, a large part of which will be planted with citrus fruits.

Modesto, Cal—At a joint meeting of the Modesto and Turlock Irrigation Directors, held Saturday last, it was decided to build a joint dam, 90 ft. high, in the Tuolumne River, 1,800 ft. above the Wheaton dam, for the use of both districts.

SEWERAGE AND MUNICIPAL.

Sewers.—*Ordered*, at Somerville, Mass., Bridgeton, and Newark, N. J., Pittsburg, Pa., and San Antonio, Tex.

Pawtucket, R. I.—An $18,800 sewer has been ordered.

Hartford, Conn.—Assessments of $5,500 have been levied for building two sewers.

Buffalo, N. Y.—2¼ and 2 ft. brick and 20, 18, 15 and 12-in. pipe sewers have been ordered.

Rochester, N. Y.—Stone and pipe sewers at an estimated cost of $26,000 have been ordered.

Wheeling, W. Va.—A large intercepting sewer will probably be built.

Kansas City, Mo.—City Engineer Butts is preparing estimates for sewers costing $1,000,000.

Joplin, Mo.—Messrs. Rosewater & Chrysler have prepared plans for a complete system, upon which work will be begun as soon as the bonds are negotiated.

Los Angeles, Cal—8-in. vitrified pipe sewers have been ordered laid in several streets.

Streets.—*Paving* has been ordered in the following cities: Brooklyn, N. Y.; Pittsburg, Pa.; Memphis, Tenn.; Paducah, Ky.; Massillon, Toronto, and Cincinnati, O.; Evansville, Ind.; Moline and Mattoon, Ill.; Houston, Tex.; San Jose, Cal.

Toronto, Ont.—City Engineer Jennings has prepared plans for a large amount of asphalt and granite paving, the estimated cost of which is $185 000.

Montreal, P. Q.—Asphalt paving will be laid on several streets. Cement and blue flagstone sidewalks have also been ordered.

Brooklyn, N. Y.—Cobblestone and Belgian block paving has been ordered.

Dunkirk, N. Y.—Macadamizing at an estimated cost of $13,500 has been ordered on two streets.

Pittsburg, Pa.—Grading, curbing and paving with cobblestone has been ordered on several streets.

Allegheny, Pa.—The electric railways have begun to pave the seven miles of streets traversed by their lines. Since the pavement they will lay does not extend the whole width of the streets the city authorities will probably appropriate the $100,000 necessary for extending it to the curbing. The total expenditure will be about $300,000.

Cincinnati, O.—City Engineer Stuart has recommended a large amount of granite block paving on concrete foundation.

Indianapolis, Ind.—Gravel roadways and brick sidewalks are ordered on several streets.

Provo, Utah.—A large number of the sidewalks in the city will be paved with asphalt. The Utah Asphaltum Co. will do the work.

Los Angeles, Cal.—Grading, surfacing with gravel, paving with bituminous limestone, and curbing with redwood has been ordered.

Bonds.—*Columbus, Ga.*—The City will probably issue bonds for the construction of a sewerage system.

Louisville, Ky.—The city will issue $600,000 of park bonds.

ELECTRICAL.

Electric Light.—*Plants proposed* at Birmingham, Ala., address J. F. B. Jackson; Dawson, Ga., address T. J. Hart; Hickman, Ky.; Hopkinsville, Tenn., address Fordes & Bro.; Shelbina, Mo., address the Mayor; Mammoth Springs, Ark., E. L. Hutchinson can give information; Las Vegas, N. Mex., address the Electric Light Co.; New Westminster, B. C., A. M. Hering is interested.

New Companies.—The Verona, Pa., & Oakmont Light Heat & Power Co. The Edison Electric Light & Power Co., Mt. Pleasant, Mich.; capital, $10,000. Buckhannon, W. Va., Electric Light Co. Clyde, N. Y., Electric Light & Power Co.; capital, $32,500. Deland, Fla., Electric Light & Ice Co.; capital, $150,000. Waynesboro, Ga., Electric Light Co.; W. A. Wilkins, Pres't. Dallas, Tex., Electric Co.; capital, $300,000; J. P. Smith is interested. Citizens' Electric Light & Power Co., Fort Worth, Tex.; capital $20,000; incorporators, H. Wells, H. Sulze and others. Orangeburg, S. C., Electric Light & Power Co.; incorporators, E. F. Slater, J. M. Oliver and C. G. Danzler.

New Bedford, Mass.—Subscription papers for a plant are now in circulation.

Shenandoah, Va.—The Land & Improvement Co. will soon erect a plant.

Parkersburg, W. Va.—The City Council has under consideration the purchase of a plant for municipal lighting. The mayor can give information.

Augusta, Ga.—An electric light and motor company was recently incorporated. R. U. Spiney can give information.

Selma, Ala.—The Gas & Electric Light Co. will establish an incandescent plant.

Three Rivers, Mich.—The Light & Power Co. is erecting a plant consisting of a 750-incandescent lamp National dynamo, a Westinghouse dynamo for arc lights and a Schuyler dynamo for supplying power.

Terrell, Tex.—An electric light company has been organized to light the city streets. The mayor can give information.

CONTRACTING.

Sewers.—*Flatbush, N. Y.*—The contract for Sub-division 1 of the sewerage system was awarded to J. Bray for $255,524. The bids ranged from that amount to $315,710.

Louisville, Ky.—The bids for the steel outfall sewer already mentioned in these columns were from 6 to 6¼ cts. per lb.

Denver, Colo.—The Barber Asphalt Co. filed the following bid (the only one received) for paving: 18,882 sq. yds. 2½ in. asphalt on 6 ins. of concrete ac $3.13 per sq. yd.; 1,749 sq. yds. 2½ in. granolithic pavement on 6 ins. of concrete, at $3.13 per sq. yd.; 1,538 sq. yds. sandstone blocks on 6 ins. of concrete at $3.33 per sq. yd.; 8,427 ft. 16, 20, 24, 28, $3, 36 and 40-in. sandstone curb, at $0.98, $1.02, $1.07, $1.14, $1.25, $1 40 and $1.60 per lin. ft.; granite subcurb at $1.45 and sandstone at $1.05 per lin. ft.; vitrified, salt-glazed sewer pipe, from 12 to 21 ins. diameter at prices ranging from $1.13 to $1.98; cement pipes of same size, from $1.21 to $2.18.

Cement.—*New York City.*—Recent bids for supplying 500 bbls. slow-setting Portland cement to the Dock Department ranged from $2.33 to $2.75 per bbl.

Broken Stone.—*New York City.*—Bids for furnishing 1,000 cu. yds. to the Dock Department ranged from $1.60 to $1.80 per cu. yd.

Rip-Rap.—*New York City.*—Recent bids to the Dock Department for furnishing rip-rap in place ranged from 67 to 97 cts. per cu. yd.

St. Clair Tunnel Approaches.—*Port Huron, Mich.* Elliott & Phin have received the contract for the approaches to this tunnel, which will consist of about 500,000 cu. yds. of steam shovel work.

PROPOSALS OPEN.

Sewers.—*Albany, N. Y.*—Excavating and laying soil and drain pipes and building settling tanks. E. Wemple Comptroller's Office, Sept. 1.

Cleveland, O.—C. G. Force, Sept. 4.

Grading.—*Brooklyn, N. Y.*—J. P. Adams, Aug. 25.

Paving.—*Brooklyn, N. Y.*—Large amount of granite repaving. J. P. Adams, Aug. 27.

Washington, D. C.—Asphalt. J. W. Douglass, Aug. 30.

Terre Haute, Ind.—Brick. F. H. Cooper, Sept. 7.

Railway Supplies.—*Savannah, Ga.*—Complete equipment for electrical road. Real Estate, Loan & Building Co.

Meridian, Miss.—Complete dummy line equipment.

Sick Quarters.—*Navy Yard, Portsmouth, N. H.*—Surgeon-General J. M. Browne, U. S. N., Washington D. C., Sept. 1.

Timber Dry Dock.—*Port Royal, S. C.*—Also floating dry dock. N. H. Farquhar, Bureau Yards and Docks, Washington, D. C.

Cast Iron Piles.—*Cambridge, O.*—For bridge at Tyner, O., T. Smith, Sept. 10.

Granite Curbing.—*Washington, D. C.*—J. W. Douglass, Sept. 4.

Sewer Pipe.—*Los Angeles.*—About 1,900 ft. 20-in. vitrified pipe, 2,160 ft. 18 in., 83 Y branches, 20 × 6 ins., and 95 Y branches 18 × 6 ins. F. S. Teed. Aug. 21.

MANUFACTURING AND TECHNICAL.

Cars.—The Lafayette Car Works have been awarded a contract to build 1,000 coal cars for the New York, Ontario & Western Ry.; these cars will be built at their branch works in Lima, O. The Raleigh & Gaston R. R. is building a number of freight cars at its shops in Raleigh, N. C. The U. S. Rolling Stock Co. of Anniston, Ala., has just completed 35 cars for the Georgia Southern & Florida R. R., 6 for the East Tennessee, Virginia & Georgia Ry., and 8 for the Savannah, Americus & Montgomery Ry. The Alabama Great Southern R. R. has ordered all its new cars, and all the old ones when overhauled, to be equipped with the National hollow iron brake beam and the Hinson coupler. The New York Central R. R. is putting 2,000 new box cars, 60,000 lbs. capacity, in service in the White, the Blue and the Midland lines, and the Boston & Albany R. R. is increasing its quota 500 cars. The new line cars are all equipped with air brakes and automatic couplers. The Tredegar Works at Richmond, Va., have recently built 300 box cars for the South Carolina Ry. The North Carolina Car Co., of Raleigh, N. C., are building 100 box cars for the Georgia, Carolina & Northern Ry.

Locomotives.—The Canadian Pacific Ry. has ordered 30 locomotives for use on their western lines. The Georgia, Carolina & Northern Ry. has ordered a number of 10-wheel consolidation engines. The Louisville, New Albany & Chicago Ry. has ordered seven engines from the Pittsburg Locomotive Works. The Rogers Works have received an order from the Nashville, Chattanooga & St. Louis Ry. for 20 freight engines.

New Companies.—Huntington, Ind., Fuel and Light Co.; capital stock, $250,000; incorporators, J. K. Brice, F. D. Townsend, J. F. Bappus and others; object, building a 25-mile pipe line. Lewis & Fowler Girder Co., Brooklyn, N. Y.; capital, $300,000; incorporators, J. W. Fowler, D. F. Lewis, C. C. Van Anglen and others. Chicago, Ill., Rapid Railroad Velocipede Co.; capital stock, $10,000; incorporators, J. H. Gray, D. W. Gale and C. Kelz. Colorado Paving and Improvement Co., Denver, Colo.; capital stock, $500,000; directors, D. Sullivan, F. P. Ernest, C. B. Rhodes and others. Aransas Pass & Harbor City Improvement Co., Aransas Pass, Tex.; capital, $6,000,000; R. B. Harrison, Pres't.

The Portland Mfg. Co., of Syracuse, N. Y., have contracts on hand for eight stand pipes and four large Young & Brennan stone crushers. They also report a brisk trade in their engine department.

Turbines, Dynamos, etc.—Anthony & Holmes, of Topeka, Kan., will build a dam to develop 5,000 HP., which will be distributed electrically. They will purchase turbines, dynamos, and other necessary plant at once.

The National Water Purifying Co. have closed a contract with Catonsville, Md., for a large filter plant. This town supplies a part of Baltimore with water.

Metal Market Prices.—*Rails*—New York: $30.50 to $31; for old iron rails, $24 to $24.50. Chicago: $33.50; old rails, $26.50 for iron, $19.50, $21, for steel. Pittsburg: $31.50 to $32; old rails, $27 to $27.50 for iron; $21.50 to $22.50 for steel.

Foundry Pig-iron.—Chicago: $15.50 to $17.50. Pittsburg: $16.25 to $17.50. New York: $16 to $18.

Track Materials.—New York: steel angle bars, 1.8 to 1.9 cts.; spikes, $2 to $2.10; track bolts, 2.8 to 3 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.95 to 2 05 cts. for iron, 2 to 2.1 cts. for steel; spikes, 2.15 cts.; track bolts, 2.85 with square, and 3 cts. with hexagon nuts. Chicago: splice bars, 2.25 cts. for steel, and 2 to 2.1 cts. for iron; spikes, 2.15 to 2.2 cts; track bolts 3 to 3.15 cts. with hexagon nuts.

Pipe.—Cast-iron, $27 to $30 per ton. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York, 4.55 to 4.65 cts.; Chicago, 4.35 to 4.4 cts.

Structural Material.—Pittsburg: angles, 2.2 to 2.25 cts.; tees, 2.8 to 2.85 cts.; beams and channels, 3.1 cts.; sheared steel bridge plates, 2.7 cts.; universal mill plates, 2.55 cts.; refined bars, 1.9 to 2 cts.; steel plates, 4.25 to 4.75 cts. for fire box; 3.2 to 3.25 cts. for flange; 3.05 cts. for shell, 2.7 to 2.75 cts. for tank. New York: beams, 3.10 cts.; plates, 2.15 to 2.20 cts.; angles, 2.25 cts.; tees, 2.5 to 2.6 cts.; channels, 3.1 cts. Chicago: angle, 2.3 cts.; tees, 2.8 to 2.9 cts.; beams, 3.2 cts.; universal plates, 2.45 to 2.55 cts.

PROPOSALS FOR GRANITE PAVING Blocks, to be used on the Streets and Avenues in the City of Washington, D. C.

OFFICE OF THE COMMISSIONERS, WASHINGTON, D. C., Aug. 11, 1890.

Sealed proposals will be received at this office until 12 o'clock M. on Thursday, Sept. 4, 1890, for furnishing granite paving blocks, to be used on various streets and avenues in the city of Washington.

Blank forms of proposals and specifications can be obtained at this office on application therefor, together with all necessary information, and bids on these forms only will be considered.

The right is reserved to reject any and all bids or parts of bids.

J. W. DOUGLASS, L. G. HINE, H. M. ROBERT, } Commissioners, D. C.

33-3t

PROPOSALS FOR GRANITE CURBING, to be used on the Streets and Avenues in the City of Washington, D. C.

OFFICE OF THE COMMISSIONERS, WASHINGTON, D. C., Aug. 11, 1890.

Sealed proposals will be received at this office until 12 o'clock M. on Thursday, Sept. 4, 1890, for furnishing granite curb, to be used on various streets and avenues in the city of Washington.

Blank forms of proposals and specifications can be obtained at this office on application therefor, together with all necessary information, and bids on these forms only will be considered.

The right is reserved to reject any and all bids or parts of bids.

J. W. DOUGLASS, L. G. HINE, H. M. ROBERT, } Commissioners, D. C.

33-3t

IMPROVEMENT OF PHILADELPHIA HARBOR. U. S. Engineer Office, 1428 Arch street, Philadelphia, Pa., Aug. 16, 1890. Sealed proposals, in duplicate, will be received at this office until 11 A. M. Tuesday, Sept. 16, 1890, and then opened, for dredging in Philadelphia Harbor, Pa., for removal of Smith's and Windmill Islands. The attention of bidders is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at large. For all information apply to C. W. RAYMOND, Major of Engineers, U. S. Army.

34-4t

Masonry and Excavation.

NOTICE TO CONTRACTORS.

The city of Austin, Tex., will receive bids until 12 o'clock noon of Oct. 15, 1890, for construction of a DAM across the Colorado River and excavation of a HYDRAULIC CANAL near Austin.

Said work involves some

17,000	cu. yds.,	dimension stone masonry;
70,000	"	rubble " "
75,000	"	earth excavation;
55,000	"	rock "

Full information, with specifications and forms for proposals, contract and bonds, may be obtained on application to John McDonald, Mayor, or Jos. P. Frizell, Engineer, Austin, Tex.

JOHN McDONALD, Mayor.

August 6, 1890. 33-4.

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ENGINEERING NEWS PUBLISHING CO.

Water-Works.

Sealed proposals will be received until noon of Thursday, Aug. 28, 1890, by the Ashland Water Supply Co., of Ashland, Ky., for the following items for the Ashland Water-Works: 15,660 ft. 4-in. cast iron pipe, 16,050 ft. 6-in. cast iron pipe, 1,550 ft. 8-in. cast iron pipe, 3,400 ft. 10-in. cast iron pipe, 8,000 ft. 12-in. cast iron pipe. All pipe to be standard weight, and weights to be specified in bids, and pipe to be tested at 300 lbs. at the factory, and to stand a pressure of 150 lbs. per square inch when laid. Twenty-five tons of special castings. Laying of the above pipe and setting of above special castings, valves and hydrants. One or two brick lined circular pump wells. One or two systems of driven wells. Two direct acting, duplex vertical, pumping engines, each of 1,500,000 galls. in twenty-four (24) hours, or one pumping engine 2,500,000 galls., together with 2 tubular boilers, all to be set up ready for use. One reservoir, of a capacity of 3,000,000 galls. Specifications of machinery, and plans and specifications of reservoir, can be obtained at the office of the Ashland Water Supply Co., Ashland, Ky., or at the office of M. M. Tidd, consulting engineer, No. 10 Tremont St., Boston, Mass. All proposals to be accompanied by a certified check for $300 payable to the Treasurer of the Ashland Supply Co. The Ashland Water Supply Co. reserve the right to reject any or all proposals. Address all proposals to J. M. GARDINER, President, Ashland Water Supply Co.

ASHLAND, Ky., Aug. 18, 1890. 34-1t

S. E. NOBLE, Prest. JNO. E. WARE, Secy. and Treas. R. F. CARTER, Supt.

The Anniston Pipe Works,

MANUFACTURERS OF

CAST IRON WATER AND GAS PIPE,

ANNISTON, - - - - ALA.

Especially adapted for the Elevation of Clear, Gritty, Thick, or Acidulous Liquids, Quickly, Cheaply and Efficiently

PATENTED U. S. AND CANADA.

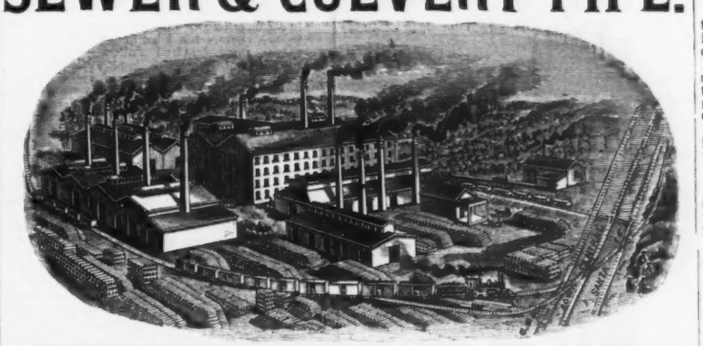
THE NEW PULSOMETER STEAM PUMP.

without Engine, Machinery, Oil, Expensive Power, Skilled Labor, or Material Wear. Send for Illustrated Catalogue.

PULSOMETER STEAM PUMP CO., 120 Liberty St., New York.

DOUBLE STRENGTH

SEWER & CULVERT PIPE.



MONMOUTH MINING & MFG. CO., MONMOUTH, ILL.

Franklinville, N. Y., Water-Works.

NOTICE TO CONTRACTORS.

Sealed proposals will be received by the Board of Water Commissioners of the village of Franklinville, New York, until six o'clock P. M., of the fourth day of September, 1890, at the office of the secretary of the board, for the material and labor to construct water-works for said village.

Proposals must be made upon blank forms furnished by the commissioners and be accompanied with cash or a certified check or draft for one thousand dollars payable to the treasurer of the Board of the Water Commissioners as a guarantee for the execution of a contract if the proposals shall be accepted. The right is reserved to reject any and all proposals.

Dated Franklinville, N. Y., Aug. 11, 1890.

A. O. HOLMES,
D. W. DEAN,
ALFRED SPRING,
SAMUEL A. SPRING.

ALFRED SPRING, Secretary. 33-3t

Notice to Contractors, Station Men and Laborers.

We are about to commence the construction of 185 miles on the Great Northern Ry. line from Assiniboine Station to the summit of the Rocky mountains in Montana. All prairie work, except the last 20 miles, and largely scraper and side work. On the last 20 miles there is considerable rock. On the extension of this line to the Pacific Coast there is some heavy work and considerable rock cutting. Parties going on to our work will be sure of employment on the work to the westward when it is commenced, and that work is expected to occupy three years. Apply by wire, letter, or in person, at our office, fourth floor, German-American Bank Building, St. Paul, Minn.

SHEPARD, SIEMS & CO.

Notice to Contractors.

Bids will be opened on the 28th of August for the letting of about three millions of brick work at this point. For specifications and plans apply at the office of The Manufacturing Investment Co., Madison, Maine. 34-2t

Artesian Well Contractors.

Sealed bids will be received up to 6 P. M. **Sept. 20, 1890,** for an artesian well to furnish not less than 200,000 gallons of water daily. Bids to be of two kinds:

1st. Total cost; no water, no pay.

2d. Price per foot of lineal depth; size of pipe to be specified in both cases.

A bond of $500 to begin work within 30 days from acceptance of bid and to complete work in reasonable time must accompany bid.

Right reserved to reject any and all bids.

M. G. RANNEY, City Secy.

YOAKUM, Tex., Aug. 13, 1890. 34-2t

To Water-Works Contractors.

Sealed bids for the furnishing of all material and constructing a system of water-works in the city of Algona, Iowa, will be received at the office of the City Clerk until 12 o'clock M., September 1, 1890. Plans and specifications will be on file at the City Clerk's office on and after August 15, 1890. Each bid to be accompanied with a certified check to the amount of $200, as a guarantee that the successful bidder will enter into a contract with said city. The right is reserved to reject any and all bids.

33-2t W. R. QUARTON, City Clerk.

LIFTING APPARATUSES.

A large *Machine Manufactory* in *Germany* seeks an *Engineer* who must be *thoroughly experienced in every respect* with the manufacture of Lifting Apparatuses, and particularly be acquainted with the latest and best constructions of *Hydraulic Lifts* and *Cranes*. Only gentlemen of the *highest ability* will please apply to R. W., 770, care of *Haasenstein & Vogler, A. G., Berlin S. W.* 34-2t

Wanted to Let.

About 500,000 cu. yds. of steam shovel excavation. Also, to buy or rent two steam shovels.

Apply to NIHAN, ELLIOTT & PHIN, Sarnia, Ont.

34-1t

QUICK PROFITS SAFE AND SURE Investigate and be convinced. Address Pittsburg Town Co., Pittsburg, Kan.

Notice to Contractors for Water Works Plant.

OFFICE OF THE COMPTROLLER, CITY OF ALLEGHENY, Aug. 7, 1890.

Sealed proposals will be received at this office until 12 o'clock noon Wednesday, October 1, 1890, for doing the following work, viz.:

PUMPING ENGINES.

For the construction and erection of two pumping engines of a capacity of 8,000,000 gallons each, to be of the type known as the vertical direct-acting three-cylinder compound condensing engines, with a combined capacity of pumping 16,000,000 gallons every 24 hours against a head of 300 feet, with a piston speed not exceeding 120 feet per minute.

RESERVOIRS.

For the construction of two basins having 450 by 660 feet surface at foot of embankments, said embankments to be 30 feet above bottom of basins. The reservoirs to have one inlet and one outlet gate chamber.

STOP GATES.

For furnishing six sixty-inch stop gates, to be doubled seated, with parallel-faced valves of easy adjustment, to be operated with two screw stems parallel to each other, and connected by suitable gear.

BOILERS.

For a 1,500 horse power boiler plant; boilers to be set up in batteries not exceeding 300 horse power, with a given guarantee on evaporative power of boiler per pound of coal consumed. Boilers will be placed in position and set up by the contractor on foundations furnished by the city.

FILTERING PLANT.

Proposals will be received for the construction and erection of a filtering plant to be used in connection with new water service, to be erected at a point nine miles up the Allegheny River. Bidders to furnish their own plans and specifications, erect their plants, and operate the same for a period of not less than six months on trial, and if satisfactory to the Committee on Water and Superintendent of Water-Works, the contract price to be paid; if not satisfactory, they to remove the plant without cost to the city.

CONDUIT AND FORCE MAINS.

For the construction and laying of a 60-inch steel or iron conduit from Nine-Mile island to the city, about 8.74 miles, to be in sections of 24 ft. in length from center to center of joints. Manholes to be provided for every 40 sections of water main. Elbows for vertical and horizontal inclinations to be provided for, with angles as shown on plan and profile. Force main to be fifty (50) inches in diameter, and constructed as per plans and specifications.

Plans and specifications for buildings reservoirs, conduit force mains and delivery pipe will be furnished by the city.

Bidders will furnish their own plans and specifications in full detail for engines and boilers, and their connections, with necessary plans for foundations for same.

Proposals will be received for the construction of the whole work, or separately, as bidders may elect.

Plans and specifications may be seen and all information in regard to the above work can be obtained at the office of the Superintendent of Water-Works, and all correspondence in relation to the same should be addressed to Edward Armstrong, Superintendent, City Hall, Allegheny, Pa.

A bond must accompany each proposal to the full amount of the bid, with sufficient sureties for the faithful performance of the contract.

The right is reserved by the Committee on Water to accept or reject bids for the whole or any part of the above work.

JAMES BROWN, Comptroller.

33-6t

Proposals for Water-Works.

MADISON, N. J., Aug. 20, 1890.

Sealed proposals addressed to the Borough Clerk, endorsed "Proposals for Water-Works," will be received by the Mayor and Council of the Borough of Madison, N. J., until 7:30 o'clock, P. M., Aug. 29, 1890, for furnishing all the materials and labor, and doing all the work required to build a system of water-works in and for the said borough.

Plans can be seen and specifications and all necessary information pertaining thereto obtained at the office of the engineer in charge. The Mayor and Council hereby reserve the right to reject any or all bids, or to accept any that in their judgment will be for the best interests of the borough. A bond for a sum equal to about one-quarter the estimated amount of contract with two or more sureties satisfactory to the Council will be required of the party to whom the contract may be awarded. Cash or a certified check made payable to the Chairman of Finance Committee for the sum of $500 must accompany each bid as a guarantee that in case the contract is awarded the party will within five days after notification of award execute said contract or forfeit said check.

Per order Mayor and Council.

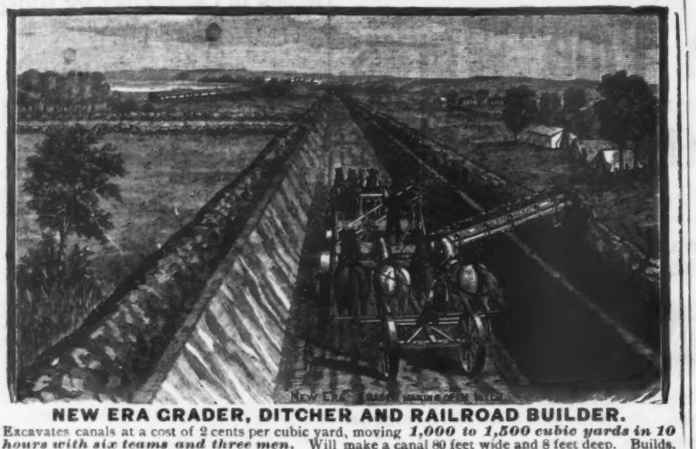
34-1t SAML. B. LEACH, Engineer.

R. R. Tracklaying.

Bids will be received for laying 35 miles of track on Albany, Florida & Northern Railroad till Sept. 5.

W. W. CAMPBELL, Chief Engineer.

CORDELE, Ga., Aug. 21, 1890. 34-1t.



NEW ERA GRADER, DITCHER AND RAILROAD BUILDER.

Excavates canals at a cost of 2 cents per cubic yard, moving ***1,000 to 1,500 cubic yards in 10 hours with six teams and three men.*** Will make a canal 80 feet wide and 8 feet deep. Builds, removes and cuts down hills by loading 600 to 800 wagons of 1¼ yards each in 10 hours at 2½ cents each. Builds railroad embankments or country turnpikes for one-quarter the cost of any other appliance. We also make the Austin-Reversible Road Machine, Buck Scrapers, Wheel and Drag Scrapers, Contractors' Plows, and Street Sweepers. Send for catalogue.

F. C. AUSTIN MFG. CO., Chicago, Ill.

DEADSTROKE

POWER HAMMERS.

OVER 600 IN USE. SEVEN SIZES. 5 to 250 pounds. IMPROVED CONSTRUCTION.

Send for Circular or References. Over 600 in Use.

DIENELT & EISENHARDT, Mkrs.,
1306 Howard St., PHILADELPHIA.

CRAM'S STEAM PILE HAMMER.

The most effective and economical

PILE DRIVING

Machine ever Constructed. **Simple in Design, Easily Operated, not liable to get out of order.** Messrs. Ross & Sanfoad, of Jersey City, say,

"In a day of 10 hours we drove 121 piles with your machine, having an average penetration of 17 feet in sand and oyster shells; and the best days work of 10 hours with the ordinary pile driver was 63 piles."

Manufactured a sold by

R. J. & A. B. CRAM,
80 Criswold St., Detroit, Mich.

BELKNAP MOTOR CO.

Little Giant Water Motors,

Comb. Motors and Dynamos, Cyclone Coffee Mill, Electric Motors and Dynamos. Lighting Plants for Water-Works Pumping Stations a Specialty.

SEND FOR DESCRIPTIVE CIRCULARS.

PORTLAND, MAINE.

TO LET.

The laving of 1,400 cu. yds. Heavy Granite and Limestone Masonry in Mississippi River at this place. Will furnish material and plant to right man.

McCORMICK & O'MEARA,
33- 904 Olive St., St. Louis, Mo.

CONTRACTORS' PLANT

For Sale Cheap.

A quantity of 6, 10 and 12-in. CAST-IRON PIPE, R. D Wood & Co. make, tested to Government standard and weights; has been used only to convey compressed air and is good as new. Also a quantity of WROUGHT-IRON PIPE 1, 2, 3 and 4 in., in good order, besides COMPRESSOR, BOILER, ENGINE, DERRICKS, 3 KNOWLES STEAM PUMPS STEAM BOILER, ONE STEAM SHOVEL, and a large amount of CONTRACTORS' PLANT. For particulars, price, etc., inquire of

BECKWITH, QUACKENBUSH, & CO.,
2,925 M. St., N. W., Georgetown, D. C.

FOR SALE.

Established business of Civil Engineering, and Surveying, located on Puget Sound, Wash. Complete notes, maps, instruments and office fixtures. Fine opportunity for young civil engineer. Address ENGINEER, care Engineering News. 33-4t

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WANTED.

To know the present address of Mr. Francis F. Hopp, a civil engineer, and within a year a resident of Birmingham, Ala.

BUFF & BERGER,
32-6t Boston, Mass.

New Court House.

Notice to Contractors.

Sealed proposals will be received by the Commissioners appointed for the purpose by the County Court of Monongalia county, West Virginia, at the office of the Clerk of the Circuit Court, in Morgantown, in said county, until 12 o'clock, noon, on Monday, September 1, 1890, for the labor and material and the construction and completion of a Court House at Morgantown, West Virginia, in accordance with the drawings and specifications furnished by John C. Fulton, Architect, copies of which may be seen at this office.

1st. All bids must be made upon the printed forms to be obtained from this office, in a sealed envelope, directed to the undersigned, and marked "Proposals for Court House at Morgantown, W. Va."

2d. As an evidence of good faith every proposal shall be accompanied by cash or certified check to the amount of three hundred dollars ($300) made payable to the County Court of Monongalia county, in case the successful bidder shall fail, for ten days after an award, to execute the required contract and bond for the faithful performance of the terms of the contract. The checks of unsuccessful bidders will be returned to them immediately after the contract is awarded or all bids rejected.

3d. The right is reserved to reject any and all bids.

4th. Bidders are requested to be present at the opening of proposals.

Morgantown, on the Monongahela River may be reached by B. & O. R. R., or from Pittsburg by daily line of steamboats.

R. E. FAST,
32-3t Secretary of Commissioners.

SITUATIONS VACANT.

WANTED.—To add to office force in large shops in Chicago, one or two Draftsmen experienced in Corliss and general engine designing; also, one or two Draftsmen experienced in mill building constructions and general machinery. Address C. F., care Engineering News. 26—

WANTED.—A first-class topographical draughtsman, one especially skilled in relief work, either pen or tint. Must be quick and reliable. Address (enclosing specimen of work and stating salary expected) NIER, HARTFORD & MITCHELL, Chattanooga, Tenn. 29-

WANTED.—Two or more graduates having had professional experience, to fill vacancies in the corps of Assistant Professors in the College of Civil Engineering, of Cornell University. Good salary and prospects for suitable candidates. Address correspondence to Professor E. A. FUERTES, Director, Ithaca, N. Y. 29-6t

WANTED.—A competent draughtsman to make shop and picture plans, highway bridge work A permanent position for first class man. Apply by letter only, giving references. Address DEAN & WESTBROOK, N o. 32 Liberty St. 32-4t

WANTED.—Four good bridge draughtsmen. None but men of experience in working drawings for this class of work need apply. THE BERLIN IRON BRIDGE CO., East Berlin, Conn. 33-2t

WANTED.—Graduate Fellowship, Vanderbilt University—A Graduate Fellowship in Engineering for the next session of the Vanderbilt University will be awarded Sept. 1, 1890. The duties will be the prosecution of advanced studies in engineering and a certain amount of assistance in the engineering laboratories and field-work. Salary, three hundred dollars ($300) and free tuition and quarters. Applicants will be required to submit a statement of and testimonials to their qualifications before the date named. For further information address

O. H. LANDRETH, Dean,
33-3t Nashville, Tenn.

WANTED.—Thomas M. Jacks, City Engineer of Helena, Ark., wants an engineer of experience to assist in the resurvey of the streets, squares, etc., of the city of Helena, Ark., embracing about 800 acres of land inhabited by 8,000 people. Applicants please address THOMAS M. JACKS, City Engineer, Box 17, Helena, Ark. 33-4t.

WANTED.—For permanent position good salary, two first-class draughtsmen for detail bridge and structural iron work shop drawings. None but the very best men wanted. Apply by letter, giving references and experiences, MILLIKEN BROS., 55 Liberty street, New York. 34-1t.

WANTED.—Four Engineers, viz.: Chief of Party, Transitman, Leveler and Topographer for a railroad survey in New England. Survey will commence positively Sept. 1. Applicants in New York and vicinity apply at once at office of BUSINESS MANAGER, Engineering News. No applications received later than Aug. 28. 34-1t

WANTED.—An experienced and competent superintendent for bridge shop engaged in first-class steel and iron riveted work. Address, giving experience and references, HILTON BRIDGE CO., Albany, N. Y. 34-2t

WANTED—A trackmaster of experience. A liberal salary will be paid. Apply by letter, giving references, to TRACKMASTER, care of Engineering News. 34-4t

WANTED.—A sober, good-tempered, experienced engineer to take charge of erection and operation of rock drills, air compressors, Corliss engines and general machinery in a mine in a foreign country; must be experienced with Ingersoll-Sergeant machinery; contract for one year, with privilege of renewal; pay $5 per day and expenses, including board and lodging; only experienced men, highly recommended, will be considered. Address WILLIAM L. SAUNDERS, 10 Park Place, New York. 34-4t

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MISCELLANEOUS.

WANTED.—Capitalists to invest in the manufacture, and to form companies to manufacture and to procure franchises to build water-works of the best water pipe and patented joint now in operation. To those wishing to become interested a strict examination of the pipe and joint is solicited. For particulars enquire of CHAS. T. LEONARD, Norwalk, Conn. 32-5t

WANTED.—Engineer's Transit, with level attachment, reading 20 or 30 seconds. Address, with particulars and price, CITY ENGINEER, Springfield, Mass. 33-2t

$20 REWARD for return of Transit stolen from buggy at my office, 91 Washington St., Chicago, November last. Made by Benj. Pike's Sons. Has full circle, vertical arc, with F. C. R. stamped in compass box. F. C. ROSSITER. 33-3t

WANTED.—A partner in a contract that promises good returns. A man who can command $50,000 can find good security and good profits. He should be a capable accountant and able to attend to the office work. Address VAN AUKEN, Engineering News. 34-3t

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FOR SALE.

Full set of 102 zinc Railroad Curves, from 5½ inches to 300 inches radius. Bevelled edges absolutely correct. Will sell cheap. Address.

L. T. ALDEN, C. E.,
FORT PAYNE, ALA.

WANTS.

50 Cts. 50 Cts

Cards of not more than one-half inch will be inserted in this column one time for 50 cents.

SITUATIONS WANTED.

WANTED.—Position by an engineer (30) experienced in railroad location and construction of heavy work, as tunneling, rock work, foundations, masonry, bridge erection and maintenance of way. Best of references. Address CIVIL ENGINEER, P. O. Box 568, Albuquerque, N. M. 31-3t

WANTED.—A civil engineer, 31 years old, graduate of a technical school, and with a varied experience, mostly on railroads, desires to ally himself with a good practising civil, mechanical or mining engineer in any good sized town of the United States. Address T. S. E., care of Jas. K. Gracie, 80 Broadway, New York. 31-3t

WANTED.—First class draughtsman with spare time will take work from engineers who desire maps neatly and correctly drawn. New York and vicinity preferred. Address "MAPS," care ENGINEERING NEWS. 32-?

WANTED.—A civil engineer and draughtsman of 15 years' experience on location and construction of railroads and water-works, wishes a position. Services available about Sept. 1. Tunneling and masonry specialties. Topography, etc. "X.," care Engineering News. 32-4t

WANTED.—A position in charge of surveys or construction; water-works or sewerage preferred; or a position likely to be permanent with a city engineer or engineering firm. Salary not less than $100 per month. Can furnish instruments and am good draughtsman. Good experience and first-class references. At liberty about Sept. 15. Address E. N. P., care ENGINEERING NEWS. 32-4t

WANTED.—Engineer having experience—railway location and construction, water-works, etc.—desires to find employment with parties in New York City or vicinity, where there is chance of permanent position. Reference. F. D., ENGINEERING NEWS. 32-6t

Engineers and Surveyors who do not steadily employ a draughtsman can have their draughting done; also, all extra work they may have attended to by an experienced Draughtsman who has opened an office for that purpose. Drawings, etc., sent by mail or express. Reference. Address FIELD BOOK, Engineering News. 33-2t

WANTED.—A civil engineer with ten years experience principally on city work would like to secure an engagement lasting from four to six months beginning about October 1. Have been five years on New York City work; been assistant engineer of an Eastern city of 40,000; city engineer of another place for two years, besides having a large practice on other general work. Can make surveys, plans and take charge of construction of works of sewerage and anything under the head of city engineering, and am an expert on the most accurate city surveying. Am also an A1 map draughtsman and can send sample of work. Some railroad experience. Can furnish my own instruments. At present in Wisconsin. Address CITY ENGINEER, care of Engineering News. 33-4t

WANTED.—Position by a young civil engineer; two years' experience as assistant city engineer, and one year's experience in bridge work; good detail draughtsman; moderate salary; good references furnished. Address J. A. BUTTS, General Delivery, Syracuse, N. Y. 34-1t

WANTED.—A young mining and civil engineer, with nearly five years of good, sound, practical experience, at present engaged, desires to make a change to the South or West, extreme Northwest preferred. Address TRANSITMAN, care of Engineering News, New York. 34-2t

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PORTLAND CEMENT PIPE CO.,

MANUFACTURERS OF

SEWER PIPE,
PORTLAND CEMENT.

PORTLAND, MAINE.

Catalogue Mailed on Application.

COWLES ALUMINUM BRASS,

Manufactured by

The Cowles Electric Smelting & Aluminum Co., Cleveland, O.

Guaranteed more than double the strength of ordinary brass or bronze. The best metal in the world for gears, pinions, pump rods, valves and valve seats, or any kind of castings requiring maximum strength with minimum weight. Castings made at our works. Strength and perfect castings guaranteed.

Also manufacturers of Aluminum Bronze, Silver Bronze, Silicon Bronze, and Aluminum Iron. Prices lately reduced.

Correspondence solicited.

FOR SALE.

Steam Shovels, Light Rails, Dump Cars, Hoists, Drills, Compressors, Electric Light Plants, Ice Machinery, Tanks, all kinds, Crushers, Pile Drivers, Scows, Saw Mills, Narrow Gauge Locomotives, Motors, Contractors' Tools and Machinery of all kinds, second hand and new.

W. S. MIDDLETON,
52 John St., • • NEW YORK.